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CONTENTS.

EDITORIALS:
Telephonic Printing . . . 969
Statistics of the Electrical Industries . . . 969
One or Two Motormen? . . . 970
Electric Fire Pumps . . . 970
The Blondel Arc Lamp . . . 971
A Ferraris Field Detector of Hertzian Waves . . . 971
Foundry Practice with Copper and Its Alloys . . . 971
Annual Meeting of the New York Electrical Society . . . 972
Incandescent Lamp Manufacturers Meet Again . . . 972
The Electrostatic Capacity of Wires, by Geo. D. Shepardson . . . 973
Imports of India-Rubber into the United States . . . 976
National Electric Light Association—Membership . . . 976
The Electrical Equipment of a Modern Type Foundry . . . 977
An X-Ray Tube Which Generates a Rich Quality and an Abundant Quantity of Bi-Ultra Violet Rays in Combination with the X-Rays, by Dr. J. Mount Bleyer . . . 982
A Wireless Telegraph Patent . . . 983
Reporting the Gordon Bennett Race by Wireless Telegraphy . . . 984
Commencement Exercises at Stevens Institute of Technology . . . 985
The Blondel Arc Lamp . . . 984
Electric Power Era in Scotland . . . 986
Steam Pipe Coverings . . . 986
Railway Men in Convention at Saratoga Springs, N. Y . . . 988
Electrical Patents . . . 989
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 990
INDUSTRIAL SECTION:
The Allen-Bradley Controller . . . 992
High-Speed Motor-Driven Pumps . . . 993
An Improved Potential Regulator for Charging Storage Batteries . . . 993
The Canadian Westinghouse Company, Limited . . . 994
The Duntley Washable Battery Cell . . . 996
A New Battery Fan Outfit . . . 996
An Enclosed Removable Fuse for Moderate Potentials . . . 996
Electric Fans in New York Theatres . . . 996
Annual Field Day . . . 996
CURRENT ELECTRICAL NEWS . . . 997

TELEPHONIC PRINTING.

A cable despatch to one of the New York daily newspapers announced recently that an Italian engineer now residing at Brussels, had invented an instrument which he calls the telecriptograph, and which will reproduce in print all conversations held over the telephone. If he has really done this, the doom of the typewriter has been sealed, since one would then have only to talk into a machine which would grind out the typewritten letters as fast as they were dictated. We surmise, however, that the inventor has not been working with English, a language, in which sounds and symbols often seem to have no connection. Probably the true meaning of the report is that the Italian engineer mentioned has been developing a machine of the telautograph class, and the reporter was a little hazy about its workings when he sent out the despatch. We are not yet far enough advanced to build a machine which will convert spoken sounds into written symbols.

STATISTICS OF THE ELECTRICAL INDUSTRIES.

Two bulletins, issued recently by the Department of Commerce and Labor, contain census reports upon the municipal electric fire and police patrol systems and street and electric railways. We made note recently of the bulletin upon central electric light and power stations.

Alarm Systems.

The electric telegraph was applied to fire-alarm systems not many years after the practicability of transmitting messages electrically had been demonstrated. The record shows that the first electric fire-alarm was put in in 1852, but the new method did not seem to appeal to the city authorities, probably because the fire-fighting apparatus of that time was owned and operated by private companies. From 1852 to 1867 only fifteen systems had been introduced, but in 1868 ten more were added. The additions during one year did not reach this figure again until 1880, and again in 1882, but from that time the number of systems introduced each year increased rapidly until 1893, when fifty-three systems were installed. From this year on the number declined, indicating that all the principal cities had or were rapidly putting in the new system. The number installed in 1902 was twenty-five, the total number then in operation being 764. The report, in addition to giving these statistics, describes the development of the fire-alarm boxes. The earlier types were not entirely successful, because, in his hurry and excitement, the person who undertook to send in a call frequently opened the box and forgot to operate the signal. These difficulties have been overcome as they were met by making the system more and more automatic. The most effective time for fighting a fire is when it begins, and in this service the electric fire-alarm systems, both manual and automatic, are invaluable.

Electric Railways.

The bulletin on street and electric railways in bulk demonstrates the marvelous development of the electric railway. It is usual to date the success of the electric railway from the Richmond (Va.) road, which was put in operation in 1887. The figures for 1902 show that there were in operation during that year 21,913 miles of single track operated by electric power. This was about ninety-seven per cent of all the street railway mileage. The total number of passengers carried during that year by all the street railways was 4,809,554,438, equivalent to sixty-three rides per inhabitant of the United States. The total output of electric generators used to operate these roads was a little over 900,000 kilowatts. The total car mileage was 1,099,256,744, nearly ninety-nine per cent of this being passenger travel. This about corresponds to a daily service of seven cars each way between the earth and the moon every day of the year. The cost of constructing and equipping these roads was

$2,167,634,077. The earnings from operation during 1902 were $247,553,999, of which $40,706,112 was surplus. The number of employés was 133,641, to whom was paid in wages during 1902, $48,642,359. These figures are indicative of the rapid growth of the electric railway, for the electric systems as pointed out comprise nearly all the street railways of the country. This showing would be surprising had not attention been called at various times to the progress made by the electric system.

More Mechanical Brakes Needed.

One or two facts brought out by the bulletins should not be overlooked. During the year covered by the report, 1,218 persons were killed and 47,429 injured by the street railways. While the persons injured form an almost inappreciable part of those carried when expressed in per cent, being 0.000025 per cent killed and 0.001 per cent injured, there were just 1,218 more killed and 47,429 more injured than one could wish. Possibly there is some connection between these figures and the fact that of the 64,618 cars 50,699 were provided with electric equipments, while less than twenty per cent were fitted with mechanical brakes. That nearly two-thirds of those killed were not passengers lends weight to the idea that the use of powerful brakes has not kept pace with the use of powerful driving mechanism.

ONE OR TWO MOTORMEN?

Two accidents, occurring within one week on the elevated system in New York, have attracted the attention of the riding public of this city to the danger which necessarily exists, to a greater or less extent, in all systems of transportation. Serious accidents happening at far-away points attract but little comment, and are soon forgotten; but when trouble occurs upon the road which we use twice a day, and particularly when this trouble interferes with our movements, the operating companies are sure to be criticised severely for negligence, followed sometimes by attempts upon the part of the city authorities to enforce regulations which they believe will reduce the risk. As a result of the two accidents mentioned, a resolution was presented to the board of aldermen of this city which provided, among other things, that every train on the elevated railroad should have two motormen. This resolution set forth that

WHEREAS, the increasing number of accidents on the elevated railroads of this city have amply demonstrated the increasing negligence of the management of these roads, by which the lives of the people who travel on these roads are constantly imperiled, and whereas the recent accident on the Third Avenue Elevated Railroad which resulted in a loss of life and injury to many passengers was caused by the present inadequate system of employing only one motorman to regulate and run a train of cars, by which method the lives of a trainload of passengers depend on one man.

How much good such a regulation would accomplish, and how much risk it might introduce are questions for discussion. The following view of the *New York Times* seems to us to be extremely sensible:

The remedy for the conditions here described, if they exist, appears to the aldermanic mind the "doubling up" of motormen. But before applying the remedy, would it not be well seriously to enquire whether the lives of people who travel by the elevated lines are put in jeopardy by the increasing carelessness of the management? As a statistical fact, we venture to say that there is not a transportation system in the world which handles a traffic comparable to that of the elevated railroads of Manhattan with so few accidents of any kind to the train mileage and with so little danger to passengers in proportion to the number carried. This immunity from accidents involving injury or loss of life is so remarkable that writers have fallen into the habit of speaking of the "luck" of the Manhattan management, as if to that and not to a very good system was due the safety of trains and structure.

But if conditions were so bad as the aldermen think them, would the remedy proposed meet the requirements of the case? It would be impossible to crowd two men into the little closet partitioned off for one. It would not hold them, and to make it larger would involve the reconstruction of the elevated rolling stock. Moreover, it is by no means certain that two men of divergent views and many topics of conversation would give any greater safety than one. They could not have equal and co-ordinate jurisdiction in the management of the train. For this reason, if the man with his hand on the controller made a mistake, the trouble to be expected would result before the other could correct it. To place them in separate cars and give each control of the train would be an impossible arrangement. If they did not happen to think alike at one and the same instant the results of independent action would be more picturesque than satisfactory.

The plan of the aldermen is an impracticable means of correcting an evil the existence of which is not established by anything in experience up to this time.

This presentation of the problem meets the case satisfactorily. When suggesting reforms, the faults of the proposed remedy should be examined carefully as well as those of the existing practice.

ELECTRIC FIRE PUMPS.

It seems rather strange that the fire-fighting machines of to-day differ from those used ten or fifteen years ago only in being somewhat more complete and more powerful. We are still using the horse-drawn, steam-driven pump, although in other work the horse is giving way before the mechanically driven vehicle, when heavy loads are to be moved rapidly; and where a small isolated pump is to be driven, the electric motor is practically the only power that is considered.

Possibly the fire departments of our large cities do not think that the automobile is yet sufficiently reliable to replace horses as a means of moving fire engines. We believe steam-propelled vehicles were tried some years ago in this country, but proved to be hard to handle. However, great progress has been made in the construction of automobiles in recent years, and it is our opinion that they are to-day more easily controlled than a team of horses. If one watches a large automobile truck making its way through a crowded street, he is at once impressed with the ease with which it is accomplished. Under similar conditions the heavy horse-drawn vehicle is slow and clumsy. In this respect the electric trucks excel all others, and where the run to be made is short and sharp, the battery equipment should not make the vehicle too unwieldy.

There also seems to be the best reasons for using fire pumps driven by electric motors in all of our large cities. Electric power is available everywhere, and at all hours of the day, and it could be made as easy to couple up the motor to a supply post as it is to couple the hose to a fire hydrant. An advantage of such an arrangement would be that, for the same weight, a much more powerful pump could be operated continuously;

and there would also be a minor advantage in having a clean, smokeless machine. The use of motor-driven pumps at fire stations is a step in the right direction, but why not go further and adopt the electric power for the portable pumps as new ones become necessary?

Motor-driven fire pumps are being introduced in foreign cities, apparently with good results, though these are usually mounted on horse-drawn vehicles. A pump of this description is lighter than a steam pump of equal power since it does away with the bulky, heavy boiler. The electric motor is better adapted for this work than the steam engine since it gives a uniform torque, or turning effort, and when used with a centrifugal pump the combination forms a remarkably compact and efficient equipment. As for reliability, an equipment of this description has nothing to fear when compared with the steam-pumping engines now used almost universally.

THE BLONDEL ARC LAMP.

The Blondel lamp, a new type of flaming arc devised by M. André Blondel, of Paris, is described on another page of this issue. As yet we are lacking in results of practical experience with this lamp, but the photometric tests show that it is highly efficient. The tests made by Dr. Wedding for the German patent office give the lamp a specific consumption of a little over one-tenth of a watt per candle. The great luminosity is due to the use of a composite carbon and the arrangement of the electrodes. The color of the light is yellow, but this can be varied somewhat by varying the composition of the electrodes. The lamp, as at present constructed, burns for about twenty hours with one trimming, the length of the positive carbon being about ten and one-half inches. While this is somewhat of a disadvantage, compared with the long-burning enclosed arc lamps, the high efficiency of the Blondel lamp certainly outweighs the disadvantage of requiring a more frequent trimming. One of the interesting points about this new development in arc lighting is that it has been obtained by means of low-current lamps. They are now made in two standard sizes, for five and three amperes, and we are promised a one-ampere size. An efficient and satisfactory arc lamp, taking only one ampere, would probably soon become popular for lighting large interiors. We have been informed that a contract for lighting the city of Grenoble, France, has been secured recently by the makers of this lamp, and the results of this trial will be watched with interest. The problem of increasing the efficiency of our electric lamps has received much attention of late, and it seems that we are now to make some decided advances.

A Ferraris Field Detector of Hertzian Waves.

During the past winter Professor Riccardo Arnò conducted at the Royal Instituto Tecnico Superiore, of Milan, an interesting piece of research work, the results of which were transmitted to the Royal Accademia deis Linceis, of Rome, on March 18, 1904. A summary of this work is given in the *Electrician* (London), June 3. After sketching briefly the history of our knowledge respecting the effect of Hertzian waves on magnetic substances, Arnò's method of adapting a Ferraris field to a magnetic wave detector is explained. The first apparatus consisted of a small disc made of a mixture of iron and steel powder and paraffine, supported from a bifilar suspension at the point of intersection of the axes of three solenoids. Through these solenoids, which were spaced 120 degrees apart, three-phase currents were passed, thus setting up a rotating field. The disc was surrounded by a coil of wire connected in the antenna circuit. The action of the magnetic field set up by the three coils produced a rotation of the disc, until the resistance torque due to the suspension balanced the deflecting force due to the magnetic field. When Hertzian waves were passed through the coil surrounding the disc it was found that the deviation of the disc increased distinctly. This action showed that there was an increase in the hysteresis of the magnetic substance upon which the experiments were made. The apparatus was afterward improved by adding to the moving system a second disc placed within a similar magnetic system. The currents through the two sets of coils were such as to cause rotation of the magnetic field in opposite directions, and in this way there was no initial deflection due to the magnetic field. The coil through which the Hertzian waves were passed was placed around but one disc. Professor Arnò's experiments have shown that the two paraffine iron powder discs could be replaced by two iron discs, or even by rings of iron, steel or nickel. In every case the effect of the Hertzian wave is to increase the deviation of the movable system. He believes that the apparatus will be of practical use, and it may also be employed for quantitative measurements.

Foundry Practice with Copper and Its Alloys.

In a paper read recently before the Electric Club, East Pittsburg, Pa., Mr. W. J. Reardon described the various precautions and methods which must be observed to obtain satisfactory castings of copper and its alloys. The process of casting is simple, the metal is not hard to melt and is not difficult to pour; but experience has shown that good results can only be obtained when great care is exercised. If the heating of the metal be prolonged, it becomes "soaked," with the result that a few minutes after pouring a small explosion takes place, blowing the sand from the flask and leaving an imperfect casting. If the heating be incomplete and the temperature too low, there will be no explosion, but the sand on the copper rises and breaks up. The metal at the gate swells, and the liquid copper continues to ooze out for some time. The result is a casting full of blow-holes. These effects are the same, regardless of the fuel employed for heating. It is equally important to have the sand at the proper temper. If it is too damp, the casting will be full of blow-holes. If it is too dry, the sand will not hold together.

It is of the utmost importance to have the copper at the proper temperature. At the present time the temper is estimated by the eye, as pyrometers have been tried, but found too sluggish, or not suitable on account of vibrations in the shop.

In mixing alloys it is important to add them in the proper proportions, and in the proper order. It is found that with alloys containing lead and tin, the lead separates out if the percentage of tin is considerably in excess of that of lead. In melting alloys, it is customary to melt first the constituents having the highest melting point, and then add others in the order of their melting points. However, this is not always necessary, as brass may be made by melting zinc and then adding copper, although the latter metal requires a temperature for melting about 2,500 degrees Fahrenheit, while zinc melts at 800 degrees Fahrenheit.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society and election of officers were held at the Electrical Testing Laboratories, June 15.

The report of the secretary showed that 101 members had been elected during the year; fifty-four had been dropped for nonpayment of dues; thirty-two had resigned, and three had died; and that the total membership is now 631.

The report of the treasurer showed that the income of the society for the year ending January 31, 1904, was $1,502.62, and the balance on hand was $34.37.

The revised constitution and by-laws were read for the second time before the society, and after being submitted to the meeting were unanimously adopted.

The executive committee of the society deserves great credit for its earnest efforts to strengthen the weak points which heretofore existed in the constitution and by-laws. In order to enlist the best services which the society was capable of affording to this end, the president appointed as a revising committee three past-presidents of the society, Messrs. Francis W. Jones, the first president of the society, Gano S. Dunn, and Arthur Williams. Their revision, which was approved by the executive committee, was that now adopted by the society.

One essential point in the new constitution is that no officer, except the secretary and treasurer, shall be eligible for immediate reelection to the same office. The provision for proposed amendments is made much more stringent than formerly. One of the principal features in the amended by-laws is the provision for a nominating committee, which now consists of eight members appointed by the president, with the president *ex-officio*. Two of these members shall be past-presidents, two shall be members of the executive committee, and four shall be non-office holding members, thus giving the largest representation on the committee to the general membership of the society.

It was unanimously voted that the thanks of the society be tendered to Messrs. Jones, Dunn and Williams for their able and valuable services.

The election of officers resulted as follows: for president, Frank J. Sprague; vice-presidents, C. S. Young, E. H. Mullin, F. C. Bates, all reelected; Albert F. Ganz, Louis B. Marks, W. S. Rugg; secretary, George H. Guy, reelected; treasurer, Henry A. Sinclair, reelected.

After the business meeting, the society was welcomed by Mr. John W. Lieb, Jr., president of the Electrical Testing Laboratories. Mr. Lieb gave a short history of the foundation of the laboratory, which has developed from a lamp testing bureau, founded by the association of Edison companies, to its present extensive and complete equipment. They had endeavored to make it a place where, at a very reasonable expense, any one could come and be sure of having tests made with accuracy and despatch. Since the laboratory has been opened all kinds of electrical tests have been conducted, especially on the photometric value of arc lamps, breakdown tests of insulating material, the effect of the distribution of light due to shades and reflectors, meter tests, the standardizing of instruments, the preparation of photometric standards, etc.

Mr. Wilson S. Howell, manager of the laboratories, gave a short address on the "Importance of Testing." Mr. Howell showed that the matter of testing was equally important to the manufacturer and to the purchaser. Among instances given of complete testing equipments, he mentioned those of the Pennsylvania Railroad Company, the Brooklyn navy yard, the General Electric and the Westinghouse companies, and it was demonstrated that the success of all these organizations was due to a great extent to their continuous testing, not only of their own purchases, but also of their own products. The Electrical Testing Laboratories had provided for the general public at a moderate price, the advantages of precision and efficiency, which had been secured in the cases mentioned only at a heavy outlay.

Dr. Clayton H. Sharp addressed the meeting on the "Equipment of the Commercial Testing Laboratory," concluding his address with an exhibition of a number of slides, the most interesting of which were made by a triple oscillograph, showing an alternating electromotive force and current set up thereby in an inductance and a capacity in parallel with each other.

After an inspection of the complete equipment of the laboratories had been made by the visitors, a collation was served.

Incandescent Lamp Manufacturers Meet Again.

About forty men prominently identified with the incandescent lamp manufacturing industry met at the Manhattan Hotel, New York, on June 10 and 11. The meeting was more largely attended than any of the previous gatherings. Several matters were discussed and passed upon, such as the issuance of a special license under the General Electric Company patents to the companies operating plants for the renewal of incandescent lamps, and the conditions defined under which such companies were allowed votes. A number of other matters were considered, and it is understood that most harmonious results were obtained and that a general improvement in the incandescent lamp is approaching. The following are some of the companies which were represented:

Downward Electric Light Company, New York, J. C. Wormley.

Sterling Electric Mfg. Company, Warren, Ohio, William Coale and Francis Granger.

Brilliant Electric Company, Cleveland, E. L. Elliott.

The Banner Electric Company, Warren, Ohio, N. L. Norris.

Franklin Electric Mfg. Company, Hartford, Chas. I. Hills and J. Camp.

U. S. Incandescent Lamp Company, St. Louis, H. G. Ferguson.

Standard Electric Mfg. Company, Niles, Ohio, James P. Gilbert.

Warren Electric and Specialty Company, Warren, Ohio, Col. E. E. Nash.

The Colonial Electric Company, Warren, Ohio, J. C. Estabrook.

Shelby Electric Company, Shelby, Ohio, J. C. Fish.

Bryan-Marsh Company, Chicago and New York, Geo. C. Keech and Guy V. Williams.

Buckeye Electric Company, Cleveland, F. S. Terry.

Munder Electric Company, Springfield, Mass., C. F. Munder and C. J. Purdie.

Sunbeam Incandescent Lamp Company, Chicago, A. S. Terry and A. V. Vanzwoll.

Independent Incandescent Lamp Company, Cleveland, W. M. Rothchild.

New York & Ohio Company, Warren, Ohio, W. D. Packard.

Fostoria Incandescent Lamp Company, Fostoria, Ohio, H. H. Geary.

General Incandescent Lamp Company, Cleveland, Joseph Insull.

National Electric Lamp Company, Cleveland, B. G. Tremaine.

Tipless Lamp Company, New York, H. J. Jaeger.

Kentucky Electric Company, Owensboro, Ky., Col. E. T. Franke.

Re-New Lamp Company, Boston, Col. H. Hastings and Geo. H. Smith.

The Phelps Company, Detroit, W. J. Phelps.

The Economical Electric Lamp Company, New York, B. Lobenthall.

General Electric Company, A. D. Page and Geo. F. Morrison.

Economy Electric Company, Warren, Ohio, Elmer W. Gillmer.

It is announced that the next meeting will be held at the Manhattan Beach Hotel, New York, in September.

THE ELECTROSTATIC CAPACITY OF WIRES.[1]

BY GEO. D. SHEPARDSON.

The electrostatic capacity of electrical conductors is of considerable importance in the case of long telephone, telegraph and electric power transmission lines, in which the strength and direction of the current vary with rapid pulsations or alternations.

The electrostatic capacity of the wires limits the speed with which submarine telegraph cables or long land lines may be operated. It limits the distance over which the telephone may operate through submarine, underground or aerial cables, and is the principal factor which limits long-distance telephony to a distance at present about two thousand miles. In the case of long-distance power transmission lines, which necessarily operate at high potentials, the current required for the electrostatic charging of the lines absorbs a very considerable output. For example, the Bay Counties Power Company in California, in transmitting power at 50,000 volts over a distance of 150 miles, finds that the electrostatic charge on the lines absorbs about forty amperes, which is the full current output of a 2,000-kilowatt or 2,700-horse-power generator. When dealing with long distances, high frequencies or high voltages, electrostatic phenomena, therefore, come to have considerable importance, and it is desirable that the engineer should be able to calculate within reasonable limits the capacity of an existing or contemplated line.

The capacity of a wire depends upon its section and length, the character of the surrounding medium and the proximity of other conductors. In nearly all cases the conductor is of circular section, which fortunately is most convenient for electrostatic calculations. In most cases the surrounding medium is air, whose dielectric constant is taken as unity.

The arrangement of other conductors is subject to many variations.

Some of the more important cases will be considered as follows:

1. A conductor within a concentric envelope.
2. Two parallel wires in air.
3. A single aerial wire with ground return.
4. Two parallel wires in air as affected by the proximity of the earth.
5. Three wires at vertices of an equilateral triangle.

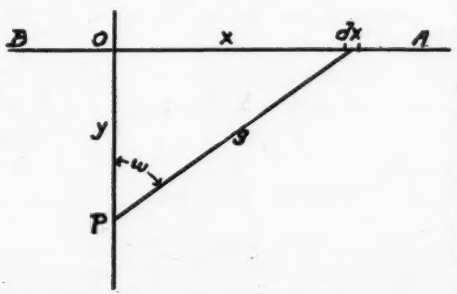
The centimetre-gramme-second electrostatic unit of quantity is defined as that quantity which repels an equal quantity at a distance of one centimetre in air with a force of one dyne. The force between two charges is directly proportional to the product of the quantities and is inversely proportional to the square of the distance between them. It also varies with the nature of the material between the two charges, being inversely proportional to a factor known as the "dielectric constant" or the "specific inductive capacity" of the material, that of air being taken as unity or the standard of reference. The force with which a quantity Q considered as concentrated at a point acts upon a unit charge at a distance D in a medium whose dielectric constant is K, is therefore,

$$f = \frac{Q}{KD^2}.$$

Suppose that a charge of Q units of electricity per unit length of wire is distributed along a wire whose length is great compared with its diameter. Consider first the force exerted upon a unit charge at any point by the charge which is distributed upon the whole length of the wire. Usually the diameter of the wire is small compared with the distances considered, so that the charge may be taken without great error as concentrated along the central axis of the wire. The charge upon an elementary length of the wire, $d\,x$, is $Q\,d\,x$. This exerts upon a unit charge at any point P a force

$$d\,F = \frac{Q\,d\,x}{K\,g^2} = \frac{Q\,d\,x}{K\,(x^2+y^2)}$$

in which g is the distance between the point P and the element of wire under consideration, y is the perpendicular distance from the point P to the wire, and x is the distance from the element of wire to the foot of the perpendicular.



This force, $d\,F$, which acts along the line g, may be resolved into two components, a component parallel to the wire,

$$d\,F' = \frac{Q\,d\,x}{K\,(x^2+y^2)} \sin\,\omega =$$

$$\frac{Q}{K}\,\frac{d\,x}{x^2+y^2}\,\frac{x}{(x^2+y^2)^{1/2}} = \frac{Q\,x\;d\,x}{K\,(x^2+y^2)^{3/2}}$$

and a component perpendicular to the wire,

$$d\,F'' = \frac{Q\,d\,x}{K\,(x^2+y^2)} \cos\,\omega =$$

$$\frac{Q}{K}\,\frac{d\,x}{(x^2+y^2)}\,\frac{y}{(x^2+y^2)^{1/2}} = \frac{Q\,y\;d\,x}{K\,(x^2+y^2)^{3/2}}$$

in which w is the angle between the perpendicular and g.

The component $d\,F'$ for any element at the right will be exactly balanced by an equal and opposite component of the force from an element at an equal distance at the left, so that the aggregate force parallel to the wire will be nil. Therefore, only the component $d\,F''$ perpendicular to the wire need be considered further. In the equation for $d\,F''$ we may substitute:

$$x = y\,\tan\,\omega$$
$$d\,x = y\,\sec^2\,\omega\,d\,\omega$$
$$x^2+y^2 = y^2\,\sec^2\,\omega.$$

and obtain as the total effective force due to an element of the charge,

$$d\,F'' = \frac{Q\,d\,x}{K\,g^2}\cos\,\omega = \frac{Q\,d\,\omega}{K\,y}\cos\,\omega.$$

To obtain the total force due to all the elements of the charge Q on the wire upon the unit charge at the point P, take the summation of the forces due to all the elements on the wire from a great distance to the right, where $\omega = +\frac{\pi}{2}$ to a great distance to the left, where $\omega = -\frac{\pi}{2}$

$$F = \frac{Q}{K\,y}\int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \cos\,\omega\,d\,\omega =$$

$$\frac{Q}{K\,y}\sin\,\omega\Big]_{-1}^{+1} = \frac{2\,Q}{K\,y}$$

The difference of potential between two points is defined to be the work required to move a unit charge from one point to the other. The work is the product of force by space. When the force varies in different parts of the space involved, the total work is the integral or summation of the force at each point by the elementary distance through which it may be considered as practically uniform. The difference of potential between a charged conductor and a point at distance D is then the integral or summation of the work done in moving a unit charge from a point infinitely near the surface of the charged conductor to the point in question, or

$$V_D = \int_r^D F\,d\,y =$$

[1] Reprinted from the Year Book of the Society of Engineers, University of Minnesota, vol. xii, 1904.

$$\int_r^D \frac{2Q}{K}\frac{dy}{y} = \frac{2Q}{K}\log_e y\Big]_r^D$$

$$= 2Q(\log_e D - \log_e r) = 2Q\log_e \frac{D}{r}$$

in which r is the radius of the conductor, or the distance from the surface to the centre, it being presumed that the net effect of the charge on the conductor is as though the whole charge were concentrated along the centre line or axis.

CAPACITY BETWEEN CONCENTRIC CONDUCTORS.

A comparatively simple case is that of an insulated conductor surrounded by a conducting sheath, such as a lead-covered cable, or an insulated wire surrounded by water or damp earth. Let r be the radius of the interior conductor, R the internal radius of the outer conductor, K the dielectric constant of the intervening insulation, and Q the charge on unit length of the inner conductor. The difference of potential between the surface of the inner conductor and the outer conductor is the work done in moving a unit charge from a point infinitely near one surface to a point infinitely near the other surface. This work is the sum of the work done against the charge on the inner conductor and of that done against the charge on the outer. The work done in moving a unit charge from one surface to the other against the charge on the inner conductor is, as shown above,

$$V = 2Q\log_e \frac{R}{r}.$$

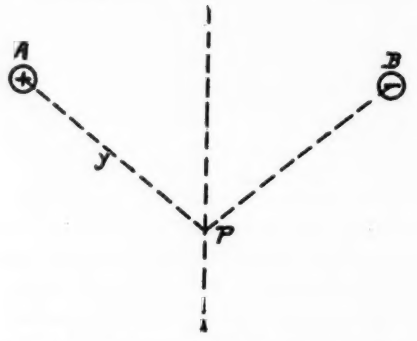
The work done against the charge on the outer conductor is zero in this case, for it may be shown that a charge uniformly distributed over a sphere or cylinder has no effect upon a charge within, the forces in all directions being mutually balanced. Therefore the work done against the charge on the inner conductor is the total work done in moving a unit charge from one surface to the other. Since the inner and outer conductors are concentric, the distance between the surfaces is the same in every direction and the above expression for the work is true in every direction between the surfaces and is general.

The capacity of a conductor, or the capacity between two conductors, is by definition equal to the quantity of charge divided by the difference of potential. Therefore, the capacity between the inner and outer surface for each unit length, and in electrostatic units is

$$C = \frac{Q}{V} = \frac{Q}{2Q\log_e \frac{R}{r}} = \frac{1}{2\log_e \frac{R}{r}}$$

CAPACITY BETWEEN TWO PARALLEL WIRES.

In the case of two parallel wires of radius r, separated by a distance D, and carrying equal and opposite charges, the capacity may be considered as consisting of two capacities between the respective wires and a plane of zero potential midway between them. Let A be a long wire with a positive charge uniformly distributed along its length, and let B be a second wire parallel to A and having an equal negative charge uniformly distributed along its length.



The work done in bringing a unit positive charge from any point P at a distance p in the neutral plane to a point infinitely near to the surface A, is the work done against the repulsion of the positive charge on A plus the work done against the attraction of the charge on B.

$$V_A = 2Q\int_r^p \frac{dy}{y} + 2Q\int_p^{D-r} \frac{dy}{y} =$$

$$2Q\left(\log_e \frac{D-r}{p} + \log_e \frac{p}{r}\right)$$

$$= 2Q\log_e \frac{D-r}{r} \simeq 2Q\log_e \frac{D}{r}.$$

Similarly, the work done in pushing a positive charge from a point infinitely near the surface of B to the neutral plane is that done against the attraction of B plus that due to the repulsion of the charge on A.

$$V_B = 2Q\int_{r'}^{p'} \frac{dy'}{y'} + 2Q\int_{p'}^{D-r'} \frac{dy'}{y'} =$$

$$2Q\left(\log_e \frac{p'}{r'} + \log_e \frac{D-r'}{p'}\right)$$

$$= 2Q\log_e \frac{D-r'}{r'}.$$

When the two wires are of the same size, $r' = r$; also r and r' are small in comparison with D, at least for aerial circuits; therefore we may write

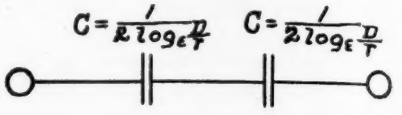
$$V_B \simeq 2Q\log_e \frac{D}{r}.$$

The capacity between either wire and the neutral plane is thus

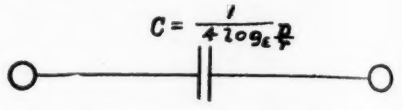
$$C = \frac{Q}{V_A} = \frac{Q}{V_B} =$$

$$\frac{Q}{2Q\log_e \frac{D}{r}} = \frac{1}{2\log_e \frac{D}{r}}$$

in which C is electrostatic units per centimetre length of wire. This is equivalent to two condensers in series between A and B, each of the capacity derived above.



These may be replaced by a single condenser whose capacity is half of one of the two. Thus:



$$C = \frac{Q}{V_A - V_B} =$$

$$\frac{Q}{2Q\log_e \frac{D}{r} + 2Q\log_e \frac{D}{r}} = \frac{1}{4\log_e \frac{D}{r}}$$

The absolute electrostatic units of capacity may be changed to practical electromagnetic units by dividing by the square of the velocity of light and multiplying by 10^9; the Naperian logarithm is changed to the common logarithm by multiplying by 2.302. Hence

$$C = \frac{10^9}{4 \times (3 \times 10^{10})^2 \times 2.302 \log_{10} \frac{D}{r}}.$$

$$= \frac{1208 \times 10^{-16}}{\log_{10} \frac{D}{r}} \text{ farads per centimetre,}$$

$$= \frac{.0000001208}{\log_{10} \frac{D}{r}} \text{ microfarads per centimetre length of line,}$$

$$= \frac{.003681}{\log_{10} \frac{D}{r}} \text{ microfarads per 1,000 feet,}$$

$$= \frac{.01942}{\log_{10} \frac{D}{r}} \text{ microfarads per mile.}$$

(Note that table iii in Foster's Handbook, page 111, is wrong in giving values with above constants as capacity per wire.)

The capacity between either wire and the neutral plane is double the amount indicated by the above coefficients.

CAPACITY BETWEEN AN AERIAL WIRE AND THE GROUND.

Since the potential of the earth is taken as the basis of reference, the surface of the earth may be considered as the neutral plane in the case of an overhead wire. The height h above the ground may then be considered as equivalent to the distance between either wire and the neutral plane of the preceding case. We may then write

$$C = \frac{1}{2 \log_e \frac{D}{r}} = \frac{1}{2 \log_e \frac{2h}{r}} = \frac{1}{2 \log_r \frac{4h}{d}}$$

in which r is the radius and d the diameter of the wire.

An aerial wire may thus be considered as a part of a circuit whose return wire is at a distance $2h$ below the wire or at a distance h below the surface of the earth. This suppositious wire is called the electrical "image" of the actual aerial wire.

The formula may be reduced to more convenient terms as before:

$C = \frac{1}{2 \log_e \frac{2h}{r}}$ electrostatic units per centimetre.

$= \frac{2416 \times 10^{-16}}{\log_{10} \frac{2h}{r}}$ farads per centimetre.

$= \frac{.0000002416}{\log_{10} \frac{2h}{r}}$ microfarads per centimetre.

$= \frac{.007362}{\log_{10} \frac{2h}{r}}$ microfarads per 1000 feet.

$= \frac{.03884}{\log_{10} \frac{2h}{r}}$ microfarads per mile.

The capacity is affected by the proximity of other conductors and by the insulating supports.

CAPACITY BETWEEN AERIAL WIRES AFFECTED BY THE EARTH.

The effect of the presence of the earth upon the capacity between aerial wires may be illustrated by analyzing the case of two wires of radius r, separated by a distance D and at a height h above the ground.

In moving a unit positive charge from any point P in the neutral plane midway between the two wires to a point infinitely near the surface of either wire, work is done against the charges on each of the wires and also against their images which are below the surface of the earth a distance equal to the height of the actual wires. Suppose that wire A is charged positively, its image B′ negatively, wire B negatively and its image A′ positively. The work done in moving a unit positive charge from any point in the neutral plane against the various charges is

$$V_A = 2Q \int_r^p \frac{dy}{y}; \quad V_B = 2Q \int_p^{D-r} \frac{dy}{y};$$

$$V_{B'} = 2Q \int_m^{2h-r} \frac{dy}{y}; \quad V_{A'} = -2Q \int_m^{\sqrt{(D-r)^2 + (2h)^2}} \frac{dy}{y}.$$

The total work is the sum, or

$$V = 2Q \left[\log_e \frac{p}{r} + \log_e \frac{D-r}{p} + \log_e \frac{2h-r}{m} - \log_e \frac{\sqrt{(D-r)^2 + (2h)^2}}{m} \right] =$$

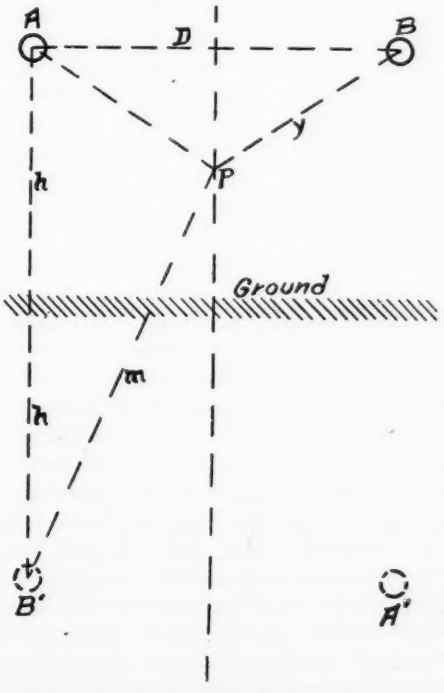
$$2Q \left[\log_e \frac{D-r}{r} - \log_e \frac{[(D-r)^2 + (2h)^2]^{\frac{1}{2}}}{2h-r} \right].$$

Since r is generally quite small as compared with $2h$ or D, we may write

$$V = 2Q \left[\log_e \frac{D}{r} - \log_e \frac{(D^2 + 4h^2)^{\frac{1}{2}}}{2h} \right] =$$

$$2Q \left\{ \log_e \frac{D}{r} - \log_e \left[1 + \left(\frac{D}{2h} \right)^2 \right]^{\frac{1}{2}} \right\}.$$

An equal amount of work is done in moving the unit charge from a point in-



finitely near the wire B to the assumed point P, so that the total work done in moving a unit charge from one wire to the other is

$$V = 4Q \left\{ \log_e \frac{D}{r} - \log_e \left[1 + \left(\frac{D}{2h} \right)^2 \right] \right\}.$$

The capacity is then,

$$C = \frac{Q}{V} = \frac{1}{4 \log_e \frac{D}{r} - 4 \log_e \left[1 + \left(\frac{D}{2h} \right)^2 \right]^{\frac{1}{2}}}$$

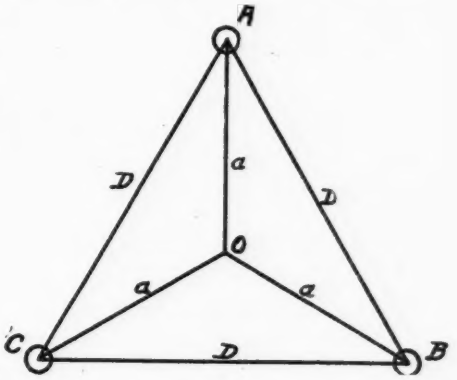
Comparing this expression for that previously obtained for the capacity between two wires without considering the earth,

$$C = \frac{1}{4 \log_e \frac{D}{r}},$$

it is seen that the presence of the earth increases the capacity between the two wires, the increase being greater as the wires are farther apart and less as they are higher above the earth. This is of importance in the design of telephone lines, which should be on high poles. The presence of grounded wires on a pole line has the effect of bringing the earth closer to the other wires, and thereby increasing their capacity.

CAPACITY OF A THREE-PHASE CIRCUIT.

The capacity of wires at the apices of an equilateral triangle, or rather at the edges of a triangular prism, is of im-



portance from the fact that most of the long-distance transmission plants use three-phase current carried on wires so arranged. The currents and pressures are 120 degrees apart, so that the sum of the currents in the three wires is zero and no fourth wire is required as common return. If the three wires are at the apices of an equilateral triangle, the centre of the triangle fixes the line of zero potential by symmetry.

If Q be the maximum positive charge on unit length of wire, then assuming that the current and pressure vary in accordance with sine law, the charges on the wires at any instant will be

$q_A = Q \sin \omega$; $q_B = Q \sin (\omega - 120°)$; $q_C = Q \sin (\omega - 240°)$

Letting a represent the distance from any wire, say A, to the centre, and D the distance between centres of wires, the work done in moving a unit positive charge

from the line of zero potential to wire A is the sum of the work done against the charges on the several wires, or

$$V = V_A + V_B + V_C$$

$$= 2\,q_A \log_e \frac{a}{r} -$$

$$2\,q_B \log_e \frac{D}{a} - 2\,q_C \log_e \frac{D}{a}$$

$$= 2\,Q \left\{ \sin\omega \log_e \frac{a}{r} - \right.$$

$$\left. [\sin(\omega - 120°) + \sin(\omega - 240°)] \log_e \frac{D}{a} \right\}$$

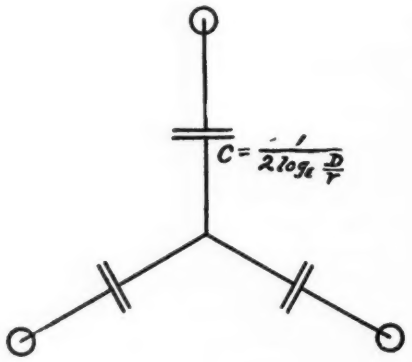
Substituting

$$\sin(\omega - 120°) =$$
$$\sin\omega \cos 120° - \cos\omega \sin 120°$$
$$= -\tfrac{1}{2} \sin\omega - (\tfrac{3}{4})^{\frac{1}{2}} \cos\omega,$$
$$\sin(\omega - 240°) =$$
$$\sin\omega \cos 240° - \cos\omega \sin 240°$$
$$= -\tfrac{1}{2} \sin\omega + (\tfrac{3}{4})^{\frac{1}{2}} \cos\omega,$$

we obtain

$$V = 2\,Q \left\{ \sin\omega \log_e \frac{a}{r} - \right.$$
$$\left[(-\tfrac{1}{2} \sin\omega - \left(\frac{3}{4}\right)^{\frac{1}{2}} \cos\omega) \right.$$
$$\left. + (-\tfrac{1}{2} \sin\omega - \left(\frac{3}{4}\right)^{\frac{1}{2}} \cos\omega) \right] \log_e \frac{D}{a} \left. \right\}$$
$$= 2\,Q \left(\sin\omega \log_e \frac{a}{r} + \sin\omega \log_e \frac{D}{a} \right)$$
$$= 2\,Q \sin\omega \log_e \frac{D}{r}.$$

Then the capacity between any wire and the neutral line is



$$C = \frac{q}{V} = \frac{Q \sin\omega}{2\,Q \sin\omega \log_e \frac{D}{r}} =$$
$$\frac{1}{2 \log_e \frac{D}{r}} \text{ electrostatic units,}$$
$$= \frac{.0000002416}{\log_{10} \frac{D}{r}}$$

microfarads per centimetre length of wire,

$$= \frac{.007362}{\log_{10} \frac{D}{r}} \text{ microfarads per 1,000 feet,}$$

$$= \frac{.03884}{\log_{10} \frac{D}{r}} \text{ microfarads per mile.}$$

Imports of India-Rubber into the United States.

According to a recent report issued by the bureau of statistics of the department of commerce and labor, the imports of india-rubber into the United States in the fiscal year about to end will exceed by far those of any earlier year, and will amount to over $40,000,000 in value. The demand for this article of exclusively foreign production, for use in manufacture, has increased very rapidly in recent years. The imports in the present fiscal year will amount to about 60,000,000 pounds. The rapid growth in the use of this article of manufacture in the United States is illustrated in the fact that the total value of india-rubber and gutta-percha imported in 1870 was less than $3,500,000; in 1880, $9,500,000; in 1890, $15,000,000; in 1900, $31,000,000, and in 1904 will be fully $40,000,000, as stated above. The increase in quantity has not been quite so rapid as the increase in value, owing to the fact that prices have advanced materially by reason of the increased demand. In 1880 the quantity of rubber imported into the United States amounted to 17,000,000 pounds, at the average price of fifty-five cents per pound. In 1890, the amount was 34,000,000 pounds, at slightly less than fifty cents per pound. In 1900, the amount was 40,000,000 pounds, at about sixty-three cents per pound. In 1904, the record for the ten months for which figures are now available shows an average value for rubber imported of sixty-eight cents per pound.

Importations of "gutta-joolatong," a product of India, which is used in certain industries as a substitute for india-rubber, now average more than 1,000,000 pounds a month, while importations of old and scrap india-rubber, to be remanufactured, amounted to over 15,000,000 pounds in the ten months of the fiscal year for which a record is now at hand.

Brazil is the most important source of this material. More than one-half of the india-rubber imported into the United States comes from that country, the total for the ten months being 30,000,000 pounds, valued at $20,500,000. The United Kingdom supplied in the same period over 7,000,000 pounds, valued at $5,250,000; Germany, 2,000,000 pounds, valued at $1,500,000. Other parts of Europe supplied nearly 10,000,000 pounds, valued at over $7,500,000. The supplies of india-rubber which come from European countries are, in practically all cases, the product of their various colonies; Germany drawing her supplies from colonies in Africa, the United Kingdom from Africa, India, Ceylon and the Straits Settlements, while the supply from other countries in Europe is chiefly that obtained in Africa by Belgium from the Congo.

National Electric Light Association—Membership.

At the twenty-seventh convention of the National Electric Light Association, held in Boston, May 24-27, an amendment to the constitution was adopted dividing the membership into six classes, as follows:

Class A, member companies—Private corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use. Entrance fee, $25; annual dues for companies in towns of less than 20,000 population, $10; 20,000 to 300,000, $25; over 300,000, $50.

Class B members—Officers or employés of member companies, elected and continued from year to year with the written consent of the member company with whom connected. Entrance fee, $5; annual dues, $5.

Class C—Instructors and teachers of engineering and related sciences. No entrance fee; annual dues, $4.

Class D, associate member companies—Electricians, electrical or mechanical engineers, manufacturers, corporations or individuals, who are directly or indirectly interested in advancing the interests of electricity. Entrance fee, $25; annual dues, $20.

Class E—Officers and employés of class D, elected and continued by written consent of the class D member employer. Entrance fee, $5; dues, $5.

Honorary members.

Reduction of the Export Tax on Rubber.

United States Consul Louis H. Aymé, at Para, Brazil, reports that the export tax on rubber imposed by the state of Amazonas has been reduced from twenty per cent of the declared value to fifteen per cent. The owner or purchaser of rubber grown outside of the state of Amazonas is at liberty to ship the rubber from Manoas or Para, as he pleases. This reduction has been brought about since the federal government has erected Acre into a territory.

The amount of rubber affected by the new regulation is estimated at not less than 7,000 tons. Of this quantity it is believed that 5,000 tons will come to Para, the value of which is about $9,000,000.

The Electrical Equipment of a Modern Type Foundry.

The Plant of the American Type Founders' Company, at Jersey City, N. J., Thoroughly Equipped with Electrical Apparatus.

THE American Type Founders' Company has established at Jersey City, N. J., a model foundry for the production of type for printing. This company is the largest manufacturer of printing type in the world, and has salesrooms and warehouses in every prominent city of the United States, as well as special agencies in many foreign countries. It has manufacturing type foundry plants in many of the largest cities. The plant at Jersey City, which is known as the central plant, has been laid out with absolutely no sparing of expense and effort to make the installation as complete as possible. The offices and workshops proper are contained in a building which has a frontage of 200 feet on Communipaw avenue, and two wings 188 feet deep extending backward, with two connecting bays, each of these bays 23 feet wide and 104 feet long, the wings in each instance being 46 feet wide. In the front of the building, which contains the executive offices of the company and the auditing department, the structure rises for three stories, the northwest corner containing three stories and a basement. The wing extending backward on the right-hand side is a two-story structure, and the wing extending backward on the left-hand side is a two-story and basement structure. The bays are both one-story structures, and have courts between. In this way there is a lighting exposure to all points of the compass. The bays are made with special glass transepts, so that there is a perfect distribution of light over all the machinery installed at this point.

The power-house which supplies current and steam for heating to the factory building and offices is located about 300 feet from the main building. This is a substantial structure, and is built on three levels, in order to accommodate the peculiar lay of the land in this locality. Both the factory building and the power-house are of brick construction throughout, the floors and ceilings being of reenforced concrete. Very little woodwork is used in the building, and the ornamentation is effected by staff work of a pleasing character. The walls are all painted white, so that with the system of electrical illumination, there are few shadows and little distortion at any point.

The construction of the factory building and power-house is fireproof throughout, so that not a dollar of insurance is carried on the buildings or contents.

The manufacture of printing types is a delicate and interesting process, the preparation of the matrices for the type-casting apparatus representing the most painstaking labor and a remarkable degree of mechanical ingenuity. A special corps of artists are constantly at work designing new faces of type. These artists' proofs must, in turn, be pantographed to proper sizes for the reproducing processes. Electrotype plates must be made from the wax etching, and these, in turn, must take their proper place in the hands of the engraver, who cuts into a brass slug the matrix for the type.

It will be understood that there enters into the mechanical operation of a factory of this nature a wide variety of machinery and a necessity for several kinds of motor service. There is a machine department where moulds are made. The product of this department calls for a remarkable degree of accuracy. The matrix-fitting department calls for another special class of machinery, and the shop for the building of machinery and the repair of machine parts calls for still another form, and the type-casting machines call for an excessive variation in speed. The product of these type-casting machines varies from type less than a sixteenth of an inch in thickness to heavy initial letters two and one-half inches wide. It is necessary, in casting, to regulate the speed of the machines, according to the size of type which is being made. It will be easy to understand that, when a large letter is being cast, there is a great deal more metal to be pumped into the mould, and this, in turn, will take considerably more time for cooling; the operation of cutting, trimming and grooving likewise taking more time than is necessary with the smaller letters. In addition to the requirements of speed control, these type-casting machines require a compressed-air service, a gas-circulating service and a cooling-water equipment.

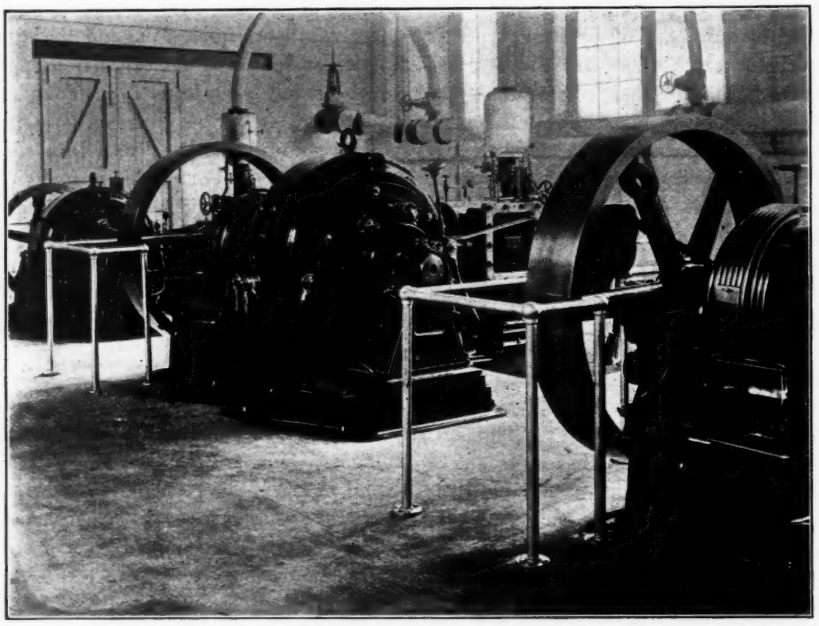
The plant has been laid out with a view of extensive additions to the present equipment. For this reason the power-house has been located at a considerable distance—as mentioned before—from the factory building. The task of engineering this proposition was left with Mr. Edward R. Knowles, 136 Liberty street, New York city, a well-known consulting engineer. That his work has been successful is attested by the perfect agreement of all the apparatus, and the satisfaction evidenced by the executive department of the American Type Founders' Company.

The power-house is divided into three sections, each fifty feet deep and fifty feet wide. The boiler room is situated on the lowest level; the engine room, containing the engines and switchboard, on the intermediate level, and a metal-smelting room on the highest level. The boiler room is equipped with two 150-horse-power Heine safety water-tube boilers. These boilers are equipped with patent "Treadkill" rocking grates and McClave "Argand" blowers for forced pressure. The boiler is served by a Cochrane feed-water heater of 500-horse-power capacity, built by the Harrison Safety Boiler Works, Philadelphia, Pa. There are two special boiler feed pumps, and one fire pump. These are all of the Deane duplex type, and are seven and one-half and five inches by six inches. There is a small pump in the pit, and a blowoff tank in this pit. This pit is located below the boiler-room level. The boiler is fed through the pumps and heater through the city water service. In order, however, that there may never be a lack of water, through a cutting off of this supply, there has been installed a water storage tank of 6,000 gallons capacity, casting machine returns, etc.

A combined muffler and grease separator is installed in the boiler room, this being located in the exhaust pipe. A by-pass is made from the main steam line to a heating main, which is equipped with a Kiely reducing valve. There is a by-pass around the reducing valve for using steam direct, if this is necessary. In the boiler flue there is placed an automatic Kiely damper regulator. The flue leads to a Custodis chimney, which is five by five feet at the base, and 100 feet high. The boilers are also equipped with patent surface blowoff cocks. The steam pressure is 135 pounds, and the steam is used non-condensing. The boiler service also includes a Metropolitan fourteen and one-half inch double-tube injector.

Steam is taken to the engines through ten-inch copper bends from the boiler to a single main header. Interpolated in this header is a Cochrane separator, which leads to a Bundy steam trap. From the

point where the separator interrupts the main header, the main is an eight-inch pipe, controlled by a gate valve. The steam chests of the engines are served by three and one-half inch copper bends, and



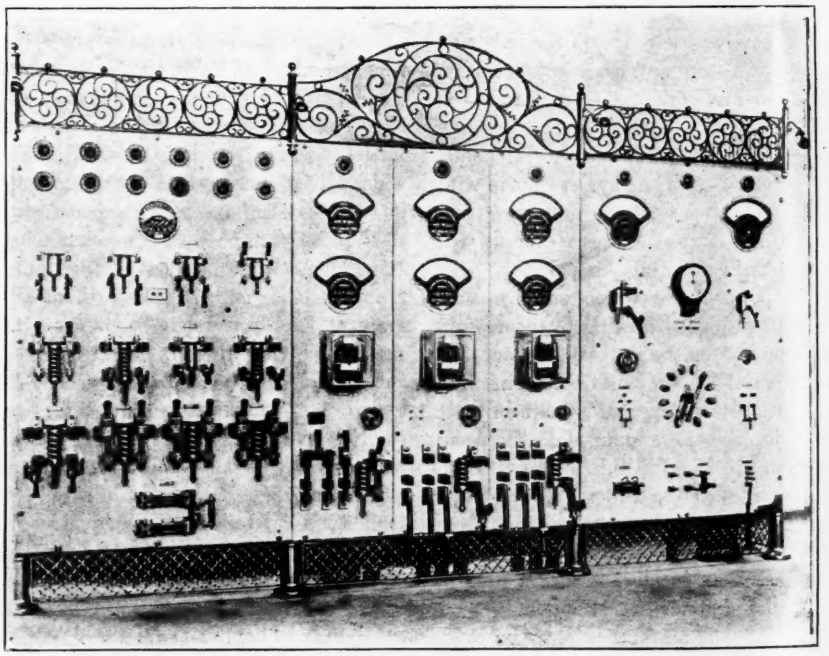
ENGINE ROOM, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.

each engine has an individual Cochrane separator in each sweep, each sweep being controlled by another gate valve. Each separator has a connection running to a common pipe, which leads to a Bundy steam trap. Each engine has a low-pressure drip, equipped with a check valve, running into a common trunk to the blow-off tank. Over each exhaust valve there is a stand controlling the valve, built by the Nelson Valve Company, New York city. This allows the engine attendant ready access to the exhaust service, in case it becomes necessary to close the main; and in each exhaust pipe a back-pressure valve is placed. A water leg at the end of the steam main carries condensed water back to a Bundy separating trap. Each of the engines is equipped with piping for indicators, and a Shephard governor is also placed on each engine. There are two tandem-compound 125-horse-power engines, built by the Skinner Engine Company, of Erie, Pa., direct-connected to seventy-five-kilowatt C. & C. generators. There is also one Woodbury engine, made by the Stearns Manufacturing Company, Erie, Pa., of sixty-horse-power capacity, nine and one-quarter by twelve inches, direct-connected to a thirty-kilowatt C. & C. generator.

A handsome gauge-board has been fitted up in the engine room, this containing two high-pressure steam gauges and a low-pressure steam gauge for the heating system. A Seth Thomas clock is located between the high-pressure steam gauges. There is also a recording steam gauge, made by the Standard Gauge Manufacturing Company. Each of the instruments is equipped with translucent dials illuminated by incandescent lamps controlled from the switchboard.

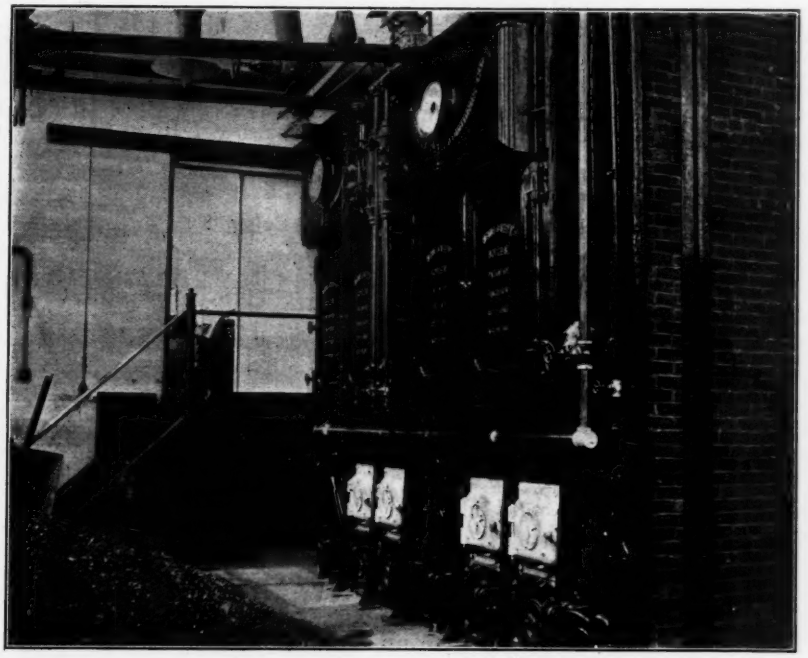
The engine room is lighted up by two enclosed arc lamps and two two-light incandescent brackets. There are a number of wall pockets situated at different points about the room, so that portable lights may be used. The illumination for the boiler room is of a similar character to that in the engine room. The Blake & Williams Company, New York city, installed the boilers and auxiliary steam apparatus.

The switchboard, built by the F. A. La Roche Company, of New York city, which is located in the engine room, is remarkably handsome and complete in every detail. This, as well as the other electrical equipment, was installed by the Tucker Electrical Construction Company, New York city. The switchboard is sixteen feet long and seven feet high. It is constructed of two-inch pink Tennessee marble. There is a highly ornamental solid-copper grill running across the entire length of the board. The board is made up of five panels. The three in the centre are the generator panels. These are each equipped with a pilot lamp, voltmeter, ammeter, recording wattmeter, field rheostat, plug for paralleling, one double-pole switch, one single-pole switch and one circuit-breaker. The panel on the left is the distribution panel. This contains twelve pilot lamps, twelve circuit-breakers from 50 to 800 amperes capacity, one 1,000-ampere double-pole switch for street service, a double-reading voltmeter for ground detector, controlled by a flush push-button switch. The right-hand panel is the battery panel. There are three pilot lamps, a double-reading ammeter for charge and discharge, one

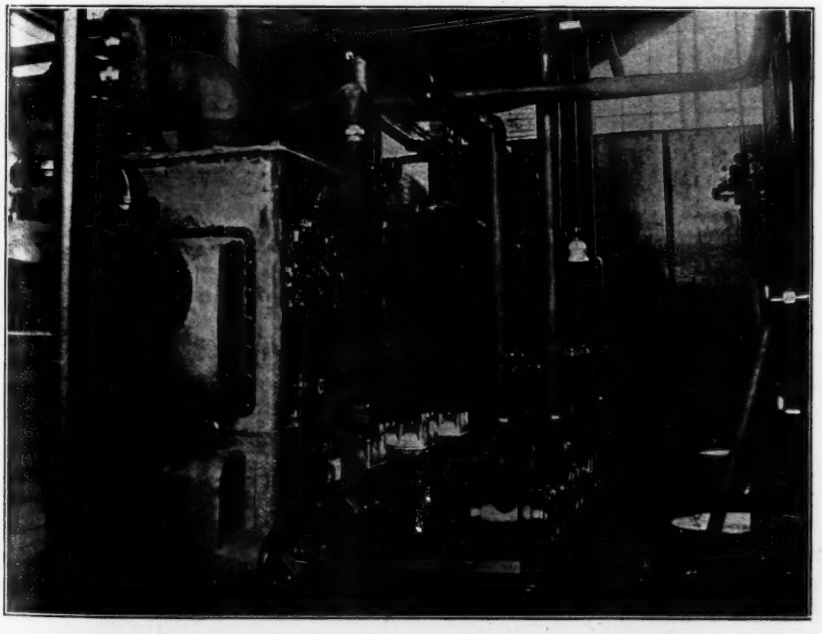


SWITCHBOARD, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.

voltmeter, battery circuit-breaker, circuit-breaker for the booster motor, Bristol recording voltmeter with double-throw switch, booster field regulator and booster field switch, one six-point double-pole booster motor switch, a three-point step-up switch for the booster motor armature, one double-pole main switch for the battery charge and discharge, an underload circuit-breaker and a twelve-point end-cell switch. At the extreme left of the board there is mounted a differential voltmeter, which is connected with the paralleling plugs on the board for coupling up the generators. One coil is connected directly to the main bus, and the other coil is connected through the paralleling plugs to the heel of each generator switch. The connections from the battery are brought into an iron pole box, and then led to the board. Lead cables are used, and these are, in turn, wound with heavy cod line and painted. All wiring in the back of the board is enclosed in "Circular Loom" and fastened to the board with brass clips. All the instruments are set in the back of the board, and are furnished with illuminated dials. From each switch upright buses convey the current to terminals at the top of the board. These terminals are fitted into lugs, from which cables are carried to an iron pole box; and from this point the circuits are led to the main buildings in an underground trench. In this trench the cables are hung on special hangers, fitted with an insulated iron sleeve lined with leather. Four lamps are situated on the grill which runs across the top of the switchboard. These lamps are connected directly onto the storage battery, so that there will always be a lighting service in the engine room. All of the cables running from the generators to the switchboard are placed in three-inch loricated iron conduits. The leads are lead-covered cables, and from the end of the conduit to the terminal on the switchboard are wrapped with heavy cod line and painted.



BOILER PLANT, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.



BOILER PLANT AUXILIARIES, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.

The storage battery consists of seventy cells of chloride accumulator, with a capacity of 125 ampere-hours. These are charged every day for two or three hours by a booster manufactured by the Electro-Dynamic Company, Philadelphia, Pa. The motor side of the booster operates at 120 volts and forty-five amperes, and the generator side operates at sixty volts and fifty amperes. The booster is mounted on a substantial pedestal, built up of concrete and faced with glazed brick.

All of the cables and steam pipes are led from the power-house to the factory building through a brick trench. In the exposed portion, the iron cover of this trench is laid over with a concrete top-cover. Entering the factory, the trench is protected by metal covers, which give ready access to any part of the distribution system. The current is brought from the power-house to a terminal board in the factory through six 1,500,000-circular-mil lead-covered cables. The terminal board is located in the northeast corner of the building. Each pair of cables is connected to a separate panel containing five switches. The three panels are then tied together with two single-throw switches. These connections are made so that it is possible to use one, two or three pairs of cables to carry the load for any particular section of the building. The main distributing board is built on the style of an ordinary panel-box, with slate-lined gutters eight inches high, slate-lined doors and marbleized panels. On the panels are mounted fifteen switches

controlling the fifteen main circuits which furnish light and power for the main building. All switches are equipped with enclosed fuses, and all of the work on this terminal board is of highly polished copper.

From the distribution board fifteen main circuits are run to individual distributing boxes, these distributing boxes controlling the local lighting and power circuits. In the machine shop on the lower floor of the right-hand wing, there are two General Electric five-horse-power motors, belt-connected to line shafts. These motors are placed on brackets, with the starting boxes directly underneath.

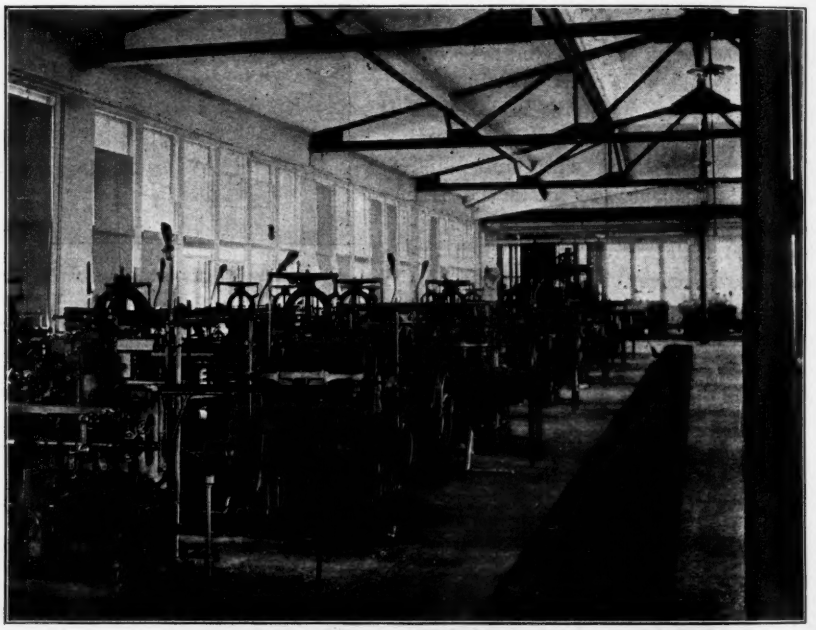
In one of the bays which has already been equipped, there are forty automatic type-casting machines. These type-casting machines are driven by three-quarter-horse-power Stow multiple-speed motors. The wiring throughout the bay is very thorough. In the centre of each bay a trench is led off from the main trench entering the building, and in this are conveyed the cables for the electrical service, the circulating water for the type-casting machines, compressed air, and gas for the Bunsen burners. Four circuits are laid in each trench, and each circuit runs to seven switch boxes. Each box contains two fifteen-ampere knife switches, fitted with enclosed fuses. From the back of each switch box two circuits are run to floor boxes, which contain waterproof floor plugs. From these plugs the wires are then carried to the respective type-casting machines in iron conduits, terminating in a small iron switch box containing a ten-ampere switch. This switch box is mounted on the casting machine, and from the switch box all leads are run to the starting box. At the heel of each switch a tap is made, and the wire is run in conduits through a special flexible metallic electric lamp fixture. The motor is back-geared to drive the casting machines, and the method of varying the speed by changing the magnetic reluctance of the field is used to give the fine gradations necessary for the type-casting apparatus.

The second bay is laid out in the same manner, except that the type-casting machines and motors will be larger. These motors will be two horse-power in capacity. There are also installed near one of the bays two nicking machines, which are driven by two and one-half horse-power specially wound Holtzer-Cabot motors. In order that the type metal be kept in a molten state, it is necessary that an intensely hot gas flame play upon the crucible. This is brought about with the use of a Bunsen burner, and compressed air is supplied through pipes which are laid through the trench already mentioned. The compressed air also serves another important purpose, in that a jet is directed through an ordinary fish-tail burner directly into the moulding receptacle, blowing away any pieces which might adhere to the mould after the cast type has been trimmed and delivered to the proper receptacle. To provide this compressed-air service there has been installed two eight by ten single straight line Clayton air compressors, connected through Renold silent chains to seven and one-half horse-power General Electric motors. These compressors serve two three by six-inch air tanks, and the work required is to furnish compressed air at a pressure of ten pounds for eighty one-sixteenth-inch openings. The compressed air is also used to create an intense heat for two gas furnaces for blacksmith's forges.

On the second floor of the building, in the northeast corner, is the engraving department. The engraving machines, of which there are eight, are driven by Holtzer-Cabot motors running at about 2,500 revolutions per minute. The motors are belted to a small countershaft, and from the countershaft a flexible shaft is driven, running at about 7,200 revolutions per minute. Two small Eck motors are used in this department for the grinders for sharpening the engraving tools.

Adjacent to this department is the draughting department, where the various designs are worked up. Proceeding from the front of the building is the mould-making department. The machinery in this department is driven by two five-horse-power General Electric motors, belt-connected to a line shaft. A feature of the machinery in this department is the magnetic chucks, made by the O. S. Walker Company, Worcester, Mass. There are four of these altogether—one large and three smaller. In addition to the magnetic chucks, there is a Walker demagnetizing machine.

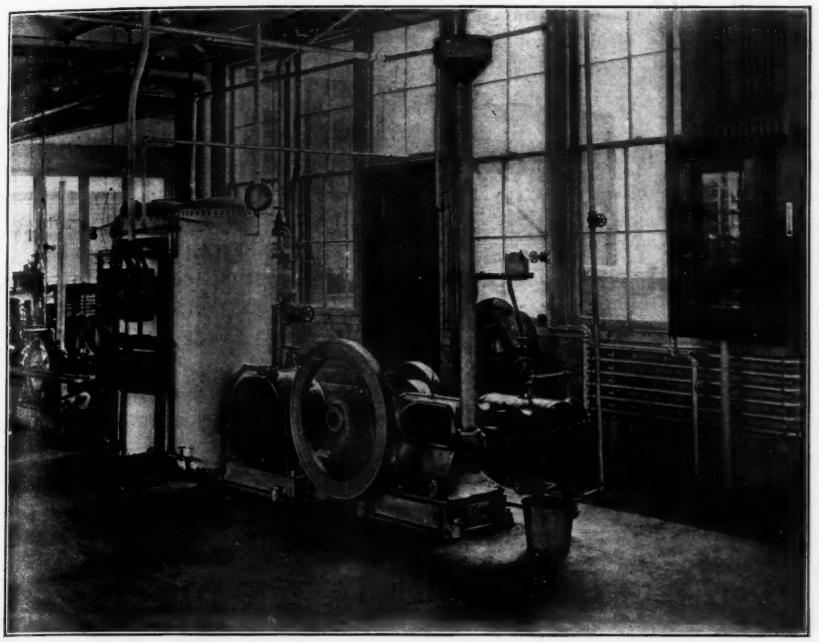
In the matrix-fitting department—which is adjacent to this machine shop—there are nine matrix cutters, direct-connected to one-third-horse-power "Lundell" motors. These are compound-wound motors, with the switch placed on top of the motor. In this department there are also located brass saws, direct-connected to one-horse-power "Lundell" motors, and one routing machine, belted to a one-half-horse-power "Lundell" motor.



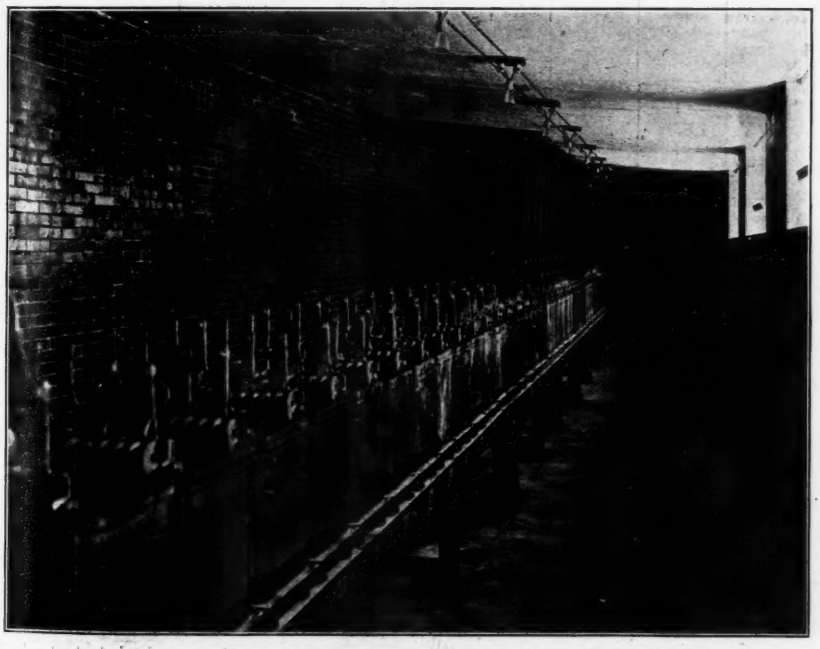
MOTOR-DRIVEN TYPE-CASTING MACHINES, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.

On the third floor, running along the front of the building, is the printing department. There are installed here five Whitlock cylinder presses, belted to three-horse-power Holtzer-Cabot motors. There are two "Universal" job presses, belted to one-half-horse-power Holtzer-Cabot motors; two Chandler & Price "Gordon" job presses, belted to one-quarter-horse-power Holtzer-Cabot motors; two cutting machines, belted to one-horse-power Holtzer-Cabot motors; one folder, belted to one-half-horse-power Holtzer-Cabot motor; one stitching machine, belted to a one-sixth-horse-power motor, and one saw,

belted to a one-sixth-horse-power motor. Each cylinder press is furnished with a type "POB" no-voltage and push-button release starting box, built by the Carpenter Enclosed Resistance Company, New York city. The motors are equipped with speed controllers of the Cutler-Hammer make.



AIR-COMPRESSOR PLANT, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.



STORAGE BATTERY PLANT, MECHANICAL EQUIPMENT, AMERICAN TYPE FOUNDERS' COMPANY, JERSEY CITY, N. J.

All of the wiring throughout the buildings is run in iron conduits. Leads are run from the different distribution boxes, and each circuit accommodates between eight and ten lights. At each outlet an iron box is placed, and in the cover of this box there is a hard rubber bushing, through which flexible cord is run, a soldered splice being made within the box.

The buildings are mainly illuminated by about 1,500 118-volt sixteen-candle-power drop lights. For general illumination, as well as for the halls, offices, etc., four-light clusters are installed. Each cluster is controlled by a pendant switch, located directly underneath. In the offices, the clusters and fixtures are controlled by flush switches placed in partitions. The panel boxes are constructed in the same manner as the main distributing board. Each switch is equipped with enclosed fuses, and the copper is all highly polished.

The wiring for the motors is all run through iron conduits, and the switches, starting boxes, etc., are placed on their respective machines, where they are within easy access of the machine operator.

The building is served by three freight elevators. There are one 10,000 and two 6,000-pound carriers. Each of these has a speed of fifty feet per minute. These elevators were built by the Marine Engine and Machine Company, of Newark, N. J., and are driven by Crocker-Wheeler motors. The elevator installation is very compact, and all of the hatchways, stairways and shafts throughout the buildings are shielded with expanded metal barriers. All the cars are equipped with lights and annunciators. One elevator runs from the basement to the third floor in the left wing. Another runs from the basement to the second floor in the same wing, and one runs from the first to the second floor in the right wing. All of these elevators are equipped with the latest safety devices, and both starting and stopping are easy and without shock. In addition to these elevators, there is another in the smelting room, which operates a small lift from the smelting-room level to the level of the main factory. There is also, in the smelting room, a five-horse-power General Electric motor mounted on the wall, which drives two stirrers through a countershaft, keeping the molten metal thoroughly mixed.

There are three automatic dumb-waiters, controlled by a push-button system. If a door is forced open, the elevator stops. The doors can not be opened normally while the elevator is running. One of these dumb-waiters runs from the basement to the third floor, one from the basement to the second floor, and another from the first floor to the second. The dumb-waiter machinery is located on the top of each dumb-waiter shaft, and is equipped with the most modern speed-control and safety devices.

The plant is completely equipped with a telephone service, and has its own private branch exchange, with about twenty stations throughout the buildings.

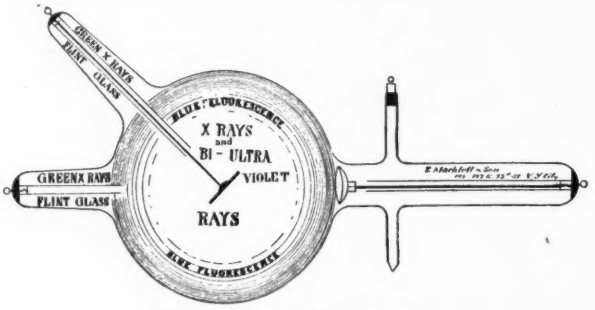
The accompanying illustrations will give an idea of the mechanical features of this plant. The flexibility of the electric drive has been taken advantage of in every instance possible, and where this has been done, it has given perfect satisfaction.

As this plant has been laid out rather with the idea in mind of making it a show feature, the American Type Founders' Company will be pleased at any time to allow an inspection of the entire installation.

An X-Ray Tube which Generates a Rich Quality and an Abundant Quantity of Bi-Ultra Violet Rays in Combination with the X-Rays.

To the Editor of the Electrical Review:

I present herewith an interesting phenomenon in connection with an X-ray tube, made of a certain composition of glass, the exact chemical formula of which I am not ready to state, as the analysis is not as yet finished for publication. Suffice it to say, that I have found a certain glass which admits a combined generation and transmission of the highest quality and quantity of both X-rays and bi-ultra violet rays in one tube.



New Form of X-Ray Tube.

It was found after some experiment that such an X-ray tube made of this peculiarly composed glass, and when placed in circuit gives these X-rays and bi-ultra violet rays a perfectly free passage through its walls, at the same time in a combined state.

The few practical experiments soon showed the value of its chemical composition. I found after tests that no X-ray tube made from any other kinds of glass gave the richness to the bi-ultra violet rays as this one did. I soon discovered that these bi-ultra violet rays are the most powerful I have ever witnessed.

Another important point in connection with this tube is that here we not only generate the bi-ultra violet rays, but also the X-rays in the same tube. Both these classes of rays have a fine quality.

In making such simple tests, as the exposure of platino-cyanide or willimite to these rays they will exhibit at short and long range a most vivid fluorescence. The spectroscope tells its own story by verifying the fact. If the electric test be applied to the bi-ultra violet rays, their presence is noted in great quantity. Such a test is considered by physicists a fine one. Other tests show similar verification.

In such a tube of which I speak, we have a great combination of both rays. The use of this tube should give satisfactory results to the therapeutist. The trained eye of a scientist can not fail to recognize and appreciate this electrical phenomenon.

I lay claim to the fact that I have first shown by experiments and demonstrated that these bi-ultra violet rays are present in this combined state and richness in an X-ray tube made from this glass.

The construction of this tube involves exactly the same principles as any ordinary X-ray tubes—no matter what their shape or style may be, excepting with the following differences, *viz*:[1] The main bulb is made entirely of this new glass. The ends which hold the metallic anode and cathode are made of flint glass and sealed into the main bulb. Otherwise there is no novelty about the entire tube.

It is for this new sort of glass that I claim the property which gives this exceedingly good transmission to these bi-ultra violet rays.

The color of both these rays, when viewed, take of a bluish opalescent hue in this tube, while the flint glass of the ordinary type of tubes glow greenish. The flint glass which is blown into this new glass bulb can be seen when the tube is generating these rays to give off the green color which is the fluorescent property of the flint glass in contradistinction.

Any class or style of X-ray tubes can be modeled from this same sort of new glass.

It is a known scientific fact that glass of different chemical composition gives various shades of colors when placed under electric discharge, as is demonstrated here in this tube.

To show that certain chemical compositions of manufactured glass do permit the transmission of the bi-ultra violet rays, I append below a schedule test which a German firm has given as its mathematical-analytical tests of such and other classes of glass, which it has succeeded in making.

It claims an extraordinary property

SCHEDULE.

Type.	Name.	Index of Refraction for D.	Medium Dispersion C to F.	V = n = 1 / 1 n	Partial Dispersion. A' to D	Partial Dispersion. D to F	Partial Dispersion. F to G'	Specific Gravity.	Remarks.
U. V. 3199	U. V. Crown	1.5035	0.00781	64.4	0.00514 / 0.658	0.00546 / 0.699	0.00432 / 0.553	2.41	Transmits best bluish.
U. V. 3248	U. V. Flint	1.5332	0.00964	55.4	0.00611 / 0.634	0.00680 / 0.705	0.00553 / 0.573	2.75	Medium transmission bluish.
U. V. 3492	U. V. Flint	1.5329	0.00964	55.2	0.00612 / 0.635	0.00680 / 0.705	0.00552 / 0.572	2.75	The same quite strong in blue color.
S. 249	Heavy U. V. Flint	1.6529	0.01270	51.4	0.00810 / 0.638	0.00896 / 0.705	0.00727 / 0.572	3.55	The best transmission is got from the pure white soft glass, only possible to manufacture small pieces with imperfections in the glass.
F. 353 786 π	Violet U. V. Glass	Filter for the smaller ray wave-lengths.							It absorbs partially the visible part of the spectrum up to the blue and allows the transmission of the ultra-violet to pass.

[1] To G. J. Monahan, of New York, I credit him with the construction of the first tube. E. Machlett & Son, 143 East Twenty-third street, New York, are manufacturing from this new glass the tube which I describe, under my instruction.

of transmission for the bi-ultra violet rays through this special manufactured glass, which the schedule shows very distinctly. I have personally tried and tested this glass and find its claim well merited. However, this glass is very hard and can be worked into X-ray tubes. It is found that it allows the bi-ultra violet rays in wave-lengths smaller than 400 cubic centimetres to pass through with great facility of transmission.[1]

Up to the present moment I am satisfied to bring this peculiar phenomenon to the notice of those interested in this scientific problem, and present the tube. I shall be pleased to have pointed out to me, however, any information which I may lack. Nevertheless, until some one shall disprove my premises, I shall hold to my discovery.[2]

DR. J. MOUNT BLEYER.
836 Lexington avenue,
New York city.

Commencement Exercises at Stevens Institute of Technology.

The annual commencement held at Stevens Institute of Technology, June 12 to 16, 1904, was carried out in the following manner:

Sunday, June 12, Rev. J. C. Mitchell, S. T. B., delivered the baccalaureate sermon at 10.45 A. M.

Wednesday, June 15, the class day exercises of the graduating class were held at 10 A. M., on the Institute campus, Castle Point. From 4 to 6 P. M., President and Mrs. Humphreys' reception to the trustees, faculty, alumni, graduating class and under graduates was held in Carnegie Laboratory of Engineering, and at 8 P. M. a meeting of the alumni association was held at Stevens Institute auditorium.

Thursday, June 16, the thirty-second annual commencement was held in Stevens Institute auditorium at 10.30 A. M., and at 3.30 P. M. a baseball game between the faculty and seniors was held at St. George cricket grounds. Then a farewell reception was tendered by the junior class to the graduating class and friends at 8 P. M., in the Carnegie Laboratory of Engineering, followed by a reunion banquet of the class of '84.

Programme of the commencement exercises was very complete. Rev. Edward Wall opened the exercises by offering a prayer, followed by introductory remarks from President A. C. Humphreys. Mr. W. P. Patterson delivered the salutatory address, and Mr. W. C. Kerr, president of the Westinghouse, Church, Kerr & Company, also trustee of the Cornell University, delivered an address to the graduating class. Then the awarding of prizes and the conferring of degrees on members of the graduating class took place, followed by conferring of the honorary degree of doctor of science on Mr. Edward Weston, LL. D., president of the Weston Electrical Instrument Company. Mr. H. B. Rane delivered the valedictory address and the Rev. J. C. Mitchell offered the benediction, followed by the finale selection from the "Wizard of Oz."

Reporting the Gordon Bennett Race by Wireless Telegraphy.

The *Gesellschaft für Drahtlose Telegraphie* arranged to report, by means of wireless telegraphy, the Gordon Bennett race, which took place on June 17, on the Taunus course, in Germany. A description of part of the apparatus used is given in the *Electrician* (London), June 3. There were three wireless telegraph stations, of which the two smaller ones were portable, being mounted on two-wheeled carts. The principal station was stationary, and was erected at Saalburg, adjoining the temporary post office of that place. The aerial wire there was supported from a pole. One of the other two stations was placed at Neuhof, and the other at Gravenwiesbach, twenty-five and seventy kilometres distant, respectively. The aerials for these two stations were provided with balloons and kites, the former to be used in quiet weather, and the latter when wind prevailed. Each portable station was carried on two carts. One, called the power cart, was equipped with a four-horse-power water-cooled gasoline engine, directly coupled to a two and one-half kilowatt alternating-current generator. This cart carried 6.6 gallons of gasoline, which is said to be sufficient for a telegraph service of thirty hours. This cart also contained an arrangement for hauling in and paying out the small captive balloons. The second cart contained the transmitting and receiving apparatus. The space on this cart was divided by a partition into two parts, the front compartment containing the high-tension apparatus, such as the induction coil, the Leyden jars, the spark-gap and the high-tension transformer. In the compartment in the back were a Morse key, two receiving apparatus and one Morse writer. Two receiver transformers and one current reverser were fixed to the partition. On one side was a bell, and on the other side an outfit for receiving telegrams by sound, this consisting of an electrolytic detector and telephone. The receiving apparatus was mounted on a spring-suspended board. The portable stations were arranged for two wave-lengths—350 and 1,050 metres. The change from the one length to the other was effected by a small switch. The wire is 200 metres long in each case.

A Wireless Telegraph Patent.

A British patent has been issued recently to Professor Reginald A. Fessenden, which relates to improvements in wave telegraphy. An abstract of the patent is given in the *Electrician* (London), June 3. The patent has for its object the sending and receiving of Hertzian waves in such a manner that any number of stations, equally close together, may be worked simultaneously. The methods that have been employed heretofore for this purpose depended upon a change in the intensity to effect the signal, and for this reason, according to Professor Fessenden, they have failed. To accomplish this result by the new system, the signals are produced by changing the periodicity of the oscillations, at the same time maintaining their intensity constant.

The principle of the patent is explained by considering a resonant curve. This is nearly horizontal, except when it rises rapidly as the frequency approaches true resonance. If a station is in tune with this frequency, a slight change in the frequency will produce large variations in the intensity of the signal received. On the other hand, since the curve is nearly horizontal for frequencies not near resonance, slight changes in the frequency will have no appreciable effect upon such stations.

The following are the claims made: first, a system of electromagnetic wave telegraphy, in which each station has a steady state impressed upon it by other sending stations, which state can be varied only by stations signaling in the proper tune; second, signaling by changing the frequency of electromagnetic waves, without substantially changing their intensity. The patent describes a means for accomplishing this change in the frequency without a change in the energy sent out. This may be done by short-circuiting a part of the inductance in the sending circuit. At the receiving station the inventor prefers to employ a receiver of a type whose indications depend upon the relative, and not upon the absolute, amount of energy received.

[1] Emier & Amend, chemists, represent this German firm in New York city. To Francis Le Roy Satterlee, Jr., M. A., director of the physical X-ray laboratory of New York Dental College, we owe the coining of the word bi-ultra violet. I find it a good one to express the degree of the ultra violet in the spectrum beyond the real ultra violet.

[2] For full information, and the study of light and ultra violet light, I refer you to a series of articles published by Dr. J. Mount Bleyer, *Journal on Tuberculosis*, April, July, October, 1902. *Medical Examiner and Practitioner* for June, July, August, September, October and November, 1903.

The Blondel Arc Lamp.

What promises to be one of the most important improvements in electric lamps made during recent years is due to André Blondel, of Paris, a distinguished French engineer. This lamp is now being exhibited in New York by Colonel W. S. Proskey, of 70 Wall street. The lamp is of the open arc type, is very brilliant, gives an excellent distribution

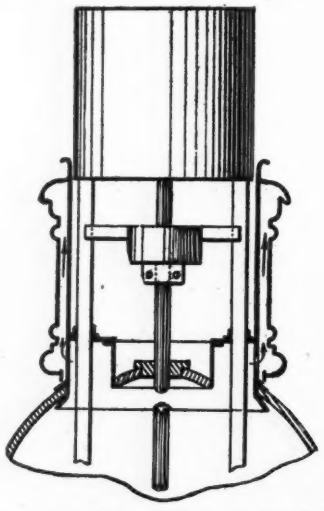


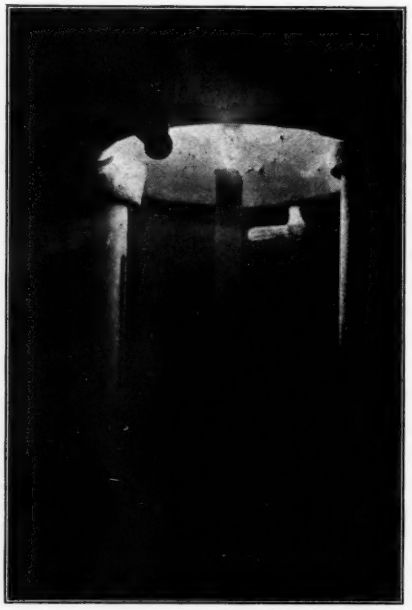
Diagram of Parts, Blondel Arc Lamp.

and a high efficiency. The quality of the light can be varied considerably and made much whiter than the ordinary carbon arc.

The peculiarities of this lamp are three: first, one of the carbons is a composite carbon—that is, it contains a proportion of certain salts which have the property of increasing the luminosity of the arc; second, in the direct-current Blondel lamps, the positive carbon is placed at the bottom; third, around the upper carbon, and just above the arc, is placed a reflector. Each of these features has a distinctive value, and adds to the effectiveness of the lamp. The arrangement is shown in the accompanying illustration.

Considering first the composite carbon, this is a cored carbon having usually three zones. The outer zone is a pure carbon, and is for the purpose of mechanical strength and providing electrical conductivity. It is thin, compared with the diameter of the carbon. Within this is a large composite core, consisting of carbon and the various light-giving salts, such as lime, magnesia or similar minerals. Within this core may be an inner core, which has the same composition as the larger core, but is subjected to less pressure, and, being on the interior, is probably baked at a somewhat lower temperature. The object of this central core is to assist in maintaining the arc at the centre of the carbon, and produce a uniform consumption of the carbon itself. These carbons are of varying sizes, depending upon the size of the lamp. That for five amperes is about one-half of an inch in diameter. They burn about half an inch per hour. The upper carbon, being the negative, is shorter, and is usually of pure carbon, though it may contain a very small part of the light-giving salts. It is usually smaller in diameter than the lower carbon. These carbons are of satisfactory size for shipping and handling, and while the best results are obtained by using different sizes for the different lamps, they can all be burned in any one lamp.

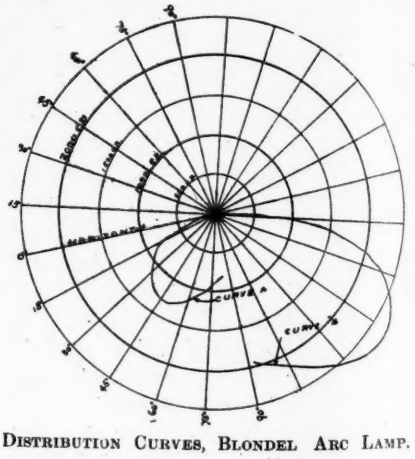
The effect of placing the positive composite carbon at the bottom is to allow the vapors given off here to rise through



The Arc and Reflector.

the arc, and thus to become highly heated. When this composite carbon is placed at the top, the vapors given off, being lighter than the cooler air around the arc, tend to rise, resulting in a flame which licks the upper carbon. With this arrangement, also, the scoria formed runs down to the tip of the carbon, and drips off; and when the lamp is shut off, an insulating layer is formed, which must be broken off before the lamp will start again. With the reverse position adopted by Blondel, these vapors pass up through the arc, and they thus add considerably to the luminosity of the arc. In fact, the lamp is a luminous arc lamp, as the light given from the carbon electrodes is inappreciable. In this position, any scoria which might form would tend to run down the lower carbon, and hence would not form an insulating layer. The lamp may be turned on or off at will, without it being necessary to clean the carbons.

The action of the reflector—or condenser, as it is sometimes called—is to confine the vapors as they rise from the arc, until they are completely consumed, and to collect the metallic oxides formed. No objectionable vapors are given off, thus permitting the lamp to be used for inside lighting. The condenser consists of a metallic ring having a concave surface downward, and containing at the centre part a ring of some insulating refractory material. In action, this condenser becomes coated quickly with white oxides, and is thus converted into a very effective light disperser. The condenser also protects the arc from disturbing air currents, so that it burns steadily, even at low values of current. The lamps are now put out for five and for three amperes, and Colonel Proskey has even succeeded in constructing a lamp which burns very satisfactorily on one ampere. The length of the arc is considerable, varying with the voltage, and being from one-half to three-quarters of an inch. The normal voltage of the lamp is fifty, but by increasing the length of the arc it may be carried up to over seventy, and still a satisfactory arc be maintained, and, apparently, with a similar increase in luminosity as secured by the larger lamps. One of the one-ampere lamps was shown in operation and, so far as could be judged



Distribution Curves, Blondel Arc Lamp.
A, three-ampere fifty-volt lamp, without globe.
B, five-ampere fifty-volt lamp, without globe.

by mere inspection, it was perfectly satisfactory, burning quietly and steadily and giving off a great deal of light. It is thought that these low-current lamps will meet with much success, particularly for interior lighting.

The value of this lamp as a source of light is very well indicated in a report made by Dr. W. Wedding, of the Royal Technical High School, Charlottenburg,

who examined the lamp for the German patent office. Dr. Wedding's results are embodied in the accompanying table.

RESULTS OF WEDDING'S TESTS OF BLONDEL LAMP.

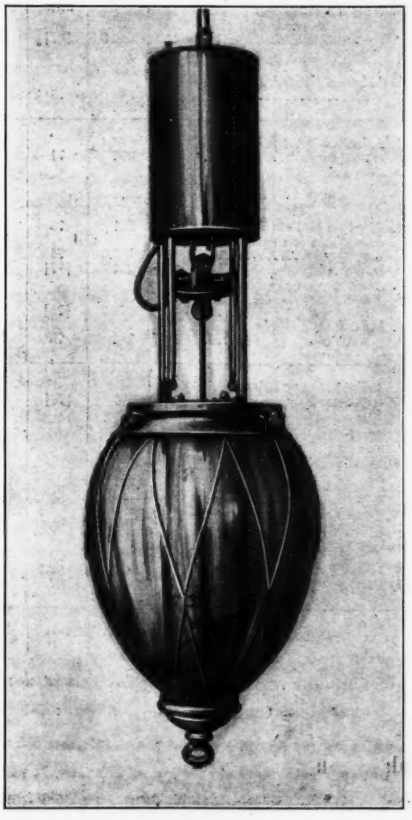
No.	Type and Arrangement of Carbons.	Voltage at Lamp Terminals.	Current in Amperes.	Watts per Lamp.	Average Hemispherical Candle-Power.	Watts per Candle.
1	Positive Blondel glower 9 millimetres in diameter, upper Siemens "A" carbon 7 millimetres in diameter...	57.4	2.99	171.5	1339	0 128
2	Same, of 11 and 7 millimetres diameter.	51.6	5.12	241.2	2210	0.109
3	Upper positive Siemens "A" cored carbon 9 millimetres in diameter, lower negative Siemens "A" solid 7 millimetres in diameter.....	53.1	2.9	154.2	207	0.746
4	Same arrangement of 11 and 9 millimetres in diameter.....	52.4	4.94	258.9	404	0.644
5	Bremer lamp.....	.....	28.6	.....	....	0.100
6	Bremer lamp.	.....	12.3	.....	....	0.126

These figures show that, with the same current intensity, the high-tension arc is more economical than the low-tension, and that of the Blondel inverted arrangement is about twenty-five per cent better than that of the other. This arrangement causes a translation of ions in the same direction as with the rising of hot gases, giving a considerably hotter burning and a steadier light.

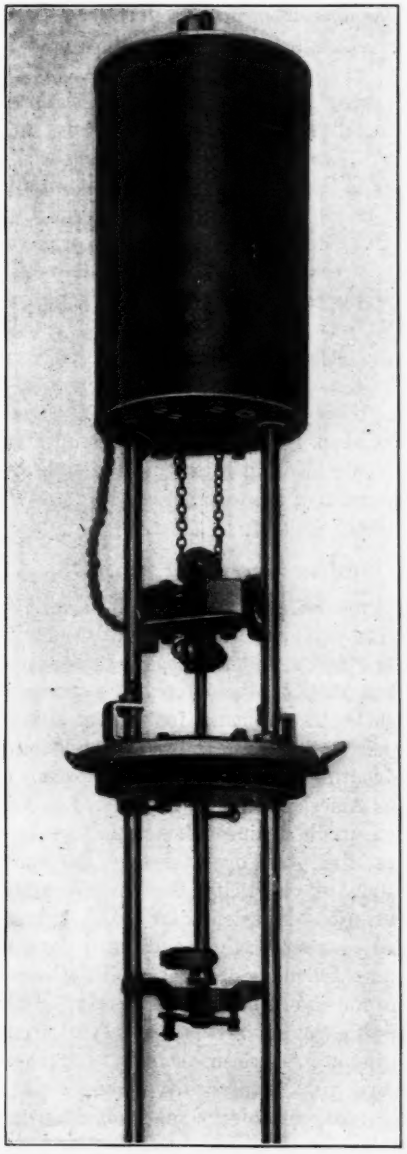
To determine whether the Blondel lamp gives better results than hitherto-known lamps, Dr. Wedding compares it with other results of flame arc lights, as follows: "The most favorable result of specific consumption has been found in the Bremer lamp, with carbons arranged side by side. This was 1.1 watt per candle. The consumption of Blondel's lamp differs from this by nine per cent. I do not attach much importance to this difference, if one considers that the consumption of 0.1 watt in a Bremer lamp can be obtained only at the exceptionally high intensity of current of twenty-eight amperes, and nearly the same result is obtained by Blondel with a lamp taking only five amperes. An important improvement has thus been made. If one considers, further, that a 12.3-ampere Bremer lamp shows the same specific consumption (0.126 watt) as a Blondel lamp taking only three amperes, it is clear that a new and considerable effect has been achieved by Blondel's lamp."

To quote further from Dr. Wedding: "Up to the present time none has succeeded in making flame arc lamps practically useful and to burn with such small currents as three amperes. This M. Blondel achieves as the result of cooperation of the different elements in his lamp. Consequently, the success of Blondel's lamp rests upon the cooperation of a number of arrangements, which will lead to new and hitherto unknown progress."

The accompanying distribution curves were obtained at the Lamp Testing Bureau, New York city. They show, when compared with the curves for the ordinary enclosed lamps, a high efficiency for the Blondel lamp. For instance, the measurements made by the National Electric Light Association's committee show that a 6.6-ampere 110-volt direct-current enclosed lamp, without the outer globe, gave a maximum luminosity of a little over 450 candles, with an expenditure of 726 watts. A five-ampere fifty-volt direct-current Blondel lamp, without the globe, gave over 2,700 candles, with an expenditure of 250 watts. It is interesting also to compare the three-ampere fifty-volt Blondel lamp—taking 150 watts—with the ordinary enclosed arc lamps. The report shows that, for the three-ampere Blondel lamp, operating at 50.3 volts, the mean hemispherical candle-power was 790 candles. The specific consumption was 0.191 watt per candle. For the five-ampere lamp, without the globe, the mean hemispherical candle-power was 1,883, and the specific consumption 0.133 watt per candle. The report of the Lamp Testing Bureau states: "The lamp burns very quietly, without hissing or noise except the occasional feeding of the carbons. The arc travels very slowly and at intervals



THE BLONDEL ENCLOSED ARC LAMP.



MECHANICAL CONSTRUCTION OF THE BLONDEL ARC LAMP.

remains stationary for considerable periods of time. There are no deep shadows from the supporting arms and the bottom of the lamp, due probably to the distributing effect of the reflecting surface referred to, and, to the eye, the illumination is fairly uniform throughout the lower hemisphere, even without the globe. The globe, of course, increases the illumination in the upper hemisphere, giving a more uniform spherical distribution. The lamp, however, can be burned if desired without a globe."

The accompanying photographs give a good idea of the appearance of the lamp. The mechanism is quite simple. There is a rocking lever connected with a train of wheels for feeding the carbon and for drawing the arc. The action of this is controlled by a series and a shunt solenoid. In other respects this lamp is similar to the familiar type. The appearance of the light is exceedingly pleasant and soft. When the five-ampere fifty-volt lamp was exhibited side by side with a five-ampere 110-volt enclosed arc, the contrast was very marked. The Blondel lamp was enclosed in a very heavy opalescent globe, and there was no shadow either on the ceiling or on the floor directly under the lamp. The ordinary arc lamp apparently added but little to the general illumination of the room.

Electric Power Era in Scotland.

United States Consul Rufus Fleming, of Edinburgh, Scotland, reports that no trade there has a better prospect at this time than that of the electrical engineering firms. The demand for motors and all other electrical apparatus will undoubtedly continue to grow from month to month, and American companies prepared to compete in these lines of manufacture have now their best opportunity. The application of electricity as a motive power in various industries, for urban lighting and traction, as light and power for coal mines and other uses, examples of which are numerous, mark the real dawn of the electric power era in this part of Great Britain. American manufacturers have in the past few years furnished some of the heavy machinery for municipal generating stations and private plants, and also a considerable number of dynamos, motors, etc. American-English concerns have done much in this line—in fact, they seem to be well ahead of all others. Recent developments mean an expanding market, to which our manufacturers of electrical machinery and supplies may find it profitable to devote earnest attention.

Steam Pipe Coverings.

An interesting and valuable series of experiments has been made by Mr. S. H. Davies with non-conductive coverings for steam pipes. His results were communicated to the Society of Chemical Industries, and the following abstract of his paper is taken from the *Mechanical Engineer,* London.

This work was begun with the object of finding a suitable covering for pipes conveying highly superheated steam. A very high temperature has therefore been maintained throughout the experiments. In most cases the temperature of the steam pipe was raised to about 250 degrees centigrade (482 degrees Fahrenheit). If steam of ninety pounds pressure is used, this is equivalent to a superheat of 150 degrees Fahrenheit.

The first method of experimenting which suggested itself was to cover considerable lengths of pipe with the material, supply a regulated quantity of superheated steam, collect and weigh the quantity of water condensed in unit time. To carry this out with any degree of accuracy is, however, extremely difficult. To supply steam at a uniform pressure, and superheated to a uniform temperature, for a considerable period is almost impossible. If this difficulty is evaded by supplying the same steam to a number of parallel pipes covered with different materials, it

TABLE I—EXPERIMENTAL DATA.

(a) Description of Covering.	(b) Mean Thickness.	(c) Temperatures. Inside Pipe.	(d) Surface of Lagging.	(e) Cold Water Jacket.	(f) Current Required to Keep Temperature Constant.	(g) Calories Lost per Hour per 250° C. Difference between the Sides.*	Remarks.
	In.	Deg. C.	Deg. C.	Deg. C.	Amperes.	Calories.	
1. Magnesia sectional, thick	1½	253	51	14.5	2.05	55	.....
2. Slag wool sectional.....	1 7/16	266.7	49	15.7	2.05	60	A thin layer of powdery material formed on the hot surface by disintegration of the fibre.
3. Remanit(waste silk rope)	⅞	249.5	50	19	2.1	60	The fibre is charred for ¼ in. depth. This is about the limit of temperature at which remanit can be used.
4. Mica, sectional, double .	2	254.5	52	17.5	2.15	61	.....
5. Morley's composite.....	1¾	220	50	21	2.0	63	It consists of slag wool surrounded by layers of hair felt and compressed fibre, covered with painted canvas.
6. Mica flexible, thick.....	2	248	53	13	2.25	68	.....
7. Mica sectional, single....	7/8	251.5	61	17.5	2.35	74	.....
8. Mica flexible, thin.....	1⅛	247	64	14	2.35	74	.....
9. Magnesia sectional, thin	3/4 1/2	230	66	12	2.4	83	.....
10. Remanit and slag wool..	1½	240.5	[67]	23	2.5	90	The cotton-fibre bag containing slag wool charred, and the contents were scattered.
11. Asbestos board and hair felt	1	233	65	17.5	2.5	91	Hair felt badly charred.
12. Asbestos rope filled with magnesia.....	1 1/16	252	71	12	3.0	118	The filling is contained in canvas surrounded by woven asbestos; the canvas is charred and the filling escapes.
13. Abestos cloth, ribbed....	1 5/16	251	75	15	3.0	120	.....
14. Abestos cloth filled with slag wool.....	7/8	248.5	75	15.2	3.0	121	Behaves like No. 12.
15. Leroy mixture, thin.....	1¾	254	[77]	11	3.15	128	.....
16. Abestos cloth containing sections filled with magnesia	1 5/16	247.5	[76]	14.7	3.1	130	.....
17. Plastic slag wool covered with black pitch	1½	255	78	11.5	3.2	132	.....
18. Asbestos rope filled with asbestos fibre.....	1¼	250	[79]	13.5	2.95	142	Owing to scarcity of material this result was obtained with 18 in. asbestos rope, plus 7 in. of magnesia sectional covering, but the result has been calculated for a complete covering of asbestos rope
19. Leroy mixture, thin.....	1 3/8	254	[80]	18.7	3.37	151	.....
20. Cresswell's plastic asbestos, No. 1.....	1	230.5	85	23	3.25	160	.....
21. Cresswell's plastic asbestos, No. 2.....	1	240	89	23.5	3.35	163	.....
22. Leroy asbestos, plastic..	1	230	89.5	24	3.4	176	.....
23. Bennett-Lawes' plastic..	1	212	87	22	3.4	191	.....
24. Bare pipe	....	177	....	18	3.45	242	.....

NOTE.—Figures in brackets are interpolated, not experimental figures.

* The last column is calculated as follows: Calories lost $= C^2 R s \frac{0.2387}{1000}$ The resistance of the heater = 14.6 ohms.

Calories lost per hour per difference of 250° between the sides $= C^2 \times 14.6 \times 60 \times 60 \times \frac{0.2387}{1000} \times \frac{250}{(c) \text{ deg.} - (e) \text{ deg.}}$

The probable experimental error does not exceed 4 per cent of the calculated heat losses.

is difficult to ensure that the supply to each pipe is uniform. I therefore abandoned this in favor of an electrical method of heating. The loss of heat was determined by simply observing the quantity of electrical energy which must be supplied to the apparatus and transformed into heat in order to maintain a uniform temperature. I am greatly indebted to Professor Stroud, of Yorkshire College, for his suggestions regarding this part of the work.

The heater (see Fig. 1) consisted of a coil of fine platinoid wire wound round a porcelain core A. This was placed in a wrought-iron steam pipe B, two inches in diameter, two feet in length, closed at one end by a blank end of iron welded into the pipe of the same thickness as

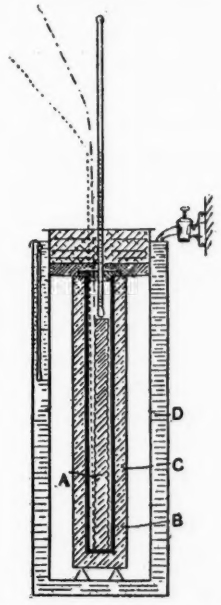


FIG. 1.—THE HEATER USED IN MAKING TESTS OF STEAM PIPE COVERINGS.

the wall of the pipe. The heater was immersed in melted paraffin wax to ensure a uniform temperature throughout the length of the pipe. The sides and closed end of the pipe were then surrounded by the lagging or insulating material C; the open end was covered with a wooden lid, perforated with holes for a thermometer and wires to convey the current to the heating coil. The steam pipe and its fittings were placed vertically in a wide tin cylinder D, and the top covered wth a closely-fitting wooden lid, and with several layers of hair felt. The loss of heat from the top end of the pipe was thus reduced to a negligible quantity. The outer cylinder was immersed in running water to secure a uniform temperature, and therefore uniform conditions for radiation from the free surface of the material.

The coil of wire on the heater was connected with the factory current, regulated by the introduction of a rheostat of incandescent lamps placed parallel with each other and in series with the heater. An ammeter was included in the circuit. A current of three to four amperes was passed through the heater until the temperature rose to about 250 degrees centigrade, and then the current was regulated by means of the rheostat until a constant temperature was obtained in the pipe. In every case this high temperature was maintained in the steam pipe over night, so that any moisture present in the covering might be expelled. An opportunity was thus given of observing any charring or disintegration of the material which might take place. The apparatus then remained under close observation, and when a constant temperature had been observed for half an hour, the temperature and flow of current were recorded.

The results of these experiments are shown in table i. Round the insulating material a few coils of thin platinoid wire were wrapped, forming a resistance thermometer for recording the temperature on the outer surface—not shown in diagram. The wire formed one arm of a Wheatstone bridge, in parallel with an equal length of wire immersed in an oil bath, which was heated or cooled until equilibrium was established, and the temperature then recorded—column (*d*). It will be seen that the results are not directly comparable, owing to the different thicknesses of material supplied by the makers. Except in the case of plastic coverings, this is, however, a matter of theoretical interest, the practical question being: what loss of heat do we obtain from steam pipes covered by the materials just as they are supplied by the makers? The figures given in column (*g*) supply an answer, giving the loss of heat per hour calculated for a difference of 250 degrees centigrade between the steam pipe and the water-jacket. For comparison, an experiment carried out with the bare steam pipe is added, and it will be seen that, with the best covering, seventy-seven to seventy-eight per cent of the heat transmitted by the bare pipe is retained, while with the worst covering examined only twenty-one per cent is retained. Pasquay states—"Wärmeschutz in Dampfbetrieb," 1895—that by using the best protective coating, in the most favorable case, about eighty to eighty-five per cent of the loss which occurs from a naked steam pipe may be avoided—a figure which corresponds closely with my results. It will be noticed that there is a group of very efficient coverings, including magnesia sectional, thick—slag wool sectional, and remanit. Secondly, comes a group of fairly efficient non-conductors, including the various mica preparations. Thirdly, there is a group which has about half the efficiency of the first named, including certain asbestos rope coverings, plastic slag wool, and the Leroy mixture. The list concludes with coverings which can not be described as non-conductors. In this connection it may be noted that while asbestos fibre may be necessary as a binding material, or asbestos cloth may be used to carry a filling, asbestos itself is not a good insulating material. Bergmehl also appears to have been overestimated in this respect.

TABLE II—COEFFICIENTS OF CONDUCTIVITY.

Covering.*	Calories per Square Metre per Hour.
1. Remanit	0.039
2. Magnesia sectional, thick	0.054
3. Slag wool sectional	0.057
4. Morley's composite	0.068
5. Mica sectional, double	0.072
6. Asbestos board and hair felt	0.073
7. Mica flexible, thick	0.081
8. Asbestos rope filled with slag wool	0.091
9. Asbestos rope filled with magnesia	0.092
10. Remanit and slag wool	0.094
11. Asbestos cloth, ribbed	0.113
12. Leroy mixture, thick	0.129
13. Asbestos rope filled with asbestos fibre	0.133
14. Asbestos cloth containing sections filled with magnesia	0.133
15. Creswell's plastic asbestos, No. 1	0.142
16. Creswell's " " No. 2	0.148
17. Plastic slag wool, covered with black pitch	0.151
18. Leroy asbestos plastic	0.161
19. Bennett-Lawes' plastic	0.181

*See note to table iii.

From the data recorded in table i it is possible to calculate, with some approach to accuracy, a coefficient of conductivity for the pipe coverings—see table ii. This coefficient expresses the number of calories lost per hour per square metre of area, by transmission through one metre of the insulating medium, with a difference of temperature of one degree centigrade between the sides. Let Q = loss of heat recorded—calories per hour; r_1 = half the outside diameter of the pipes in centimetres; r_2 half the outside diameter of the lagging in centimetres; l = length of pipe in centimetres—instead of considering the closed end of the tube separately, it is treated as an addition to the length of the tube; t_1 = temperature inside pipe; t_2 = temperature on the surface of the lagging. Then the coefficient of conductivity

$$K = \frac{Q \log \epsilon \left(\frac{r_2}{r_1}\right) .100}{2 \pi l . (t_1 - t_2)}$$

This assumes that the conductivity of the iron pipe is infinitely great com-

pared with the conductivity of the lagging—an assumption which does not introduce any appreciable error. In certain classes of work the weight of the covering is important; details of the actual weight of covering on the two-foot length of pipe, as well as the weight per cubic foot, will be found in table iii. I have not found it possible to prepare a table of costs, but in this connection it is obvious that an extra capital outlay on a good insulator may lead to very important economies in the fuel required for steam raising.

In a factory with which I am acquainted the total area of pipes employed in the distribution of steam from the boiler house to all parts of the factory is 730 square metres. At the moderate computation of three kilogrammes of steam condensed per square metre of naked pipe per hour, the condensation would amount to 2,190 kilogrammes of water per hour if the pipes were uncovered, representing a loss of 2,750 tons of coal per annum. Nearly eighty per cent of this loss may be avoided by the use of an efficient covering. With the increasing tendency to use high-pressure steam and superheated steam, the importance of selecting a good insulating medium is greatly enhanced. In the factory referred to above I have made a number of observations regarding the amount of condensed moisture present in the steam at different points. In each case steam has been traveling at a fair rate past the point at which the test has been made. A large calorimeter was used, made of tinplate surrounded by hair felt and wood, and provided with a lid of similar material and a disc stirrer. About 100 kilogrammes of cold water were used, and from ten to twelve kilogrammes of steam condensed. The rise in temperature was about sixty degrees centigrade. Starting with superheated steam from the boiler house at about ninety pounds pressure and a temperature of about 550 degrees Fahrenheit, I have recorded from zero to twelve per cent of condensed moisture in the steam at distances of 140 feet to 460 feet. A mean of eleven satisfactory experiments gave 6.2 per cent of condensed moisture. The distributing pipes were covered, but not in a very efficient manner. During a period when the steam was not superheated, other conditions remaining the same, a mean of twelve satisfactory tests gave 13.5 per cent of condensed moisture. This may serve as a further illustration of the extraordinary loss of energy resulting from the condensation of steam during its distribution in any large factory, and the great importance of securing an adequate covering for the distributing mains.

TABLE III—DENSITY OF MATERIALS.

Description of Covering.	Length.	Thickness.	Outside Diameter.	Weight in Grammes Covering Sides and One End of Pipe.	Weight per Cubic Foot in Pounds.
	Ft. In.	In.	In.		
1. Remanit	2 3	1/2	4 1/4	740	11
2. Asbestos cloth and hair felt	2 1	1	4 3/8	1080	14
3. Remanit and slag wool	2 1 1/4	1 3/8	5 1/8	2000	16
4. Magnesia sectional, thick	2 1 1/2	1 1/2	5 3/8	2050	17
5. Morley composite covering	2 1 1/2	1 1/2	5 1/4	3150	20
6. Leroy mixture, thick	2 1	1 1/4	4 3/4	1925	21
7. Asbestos rope filled with magnesia	2 1	1 3/16	4 1/4	1570	24
8. Asbestos cloth and magnesia	2 1 1/8	1 1/16	5	2540	25
9. Asbestos cloth, ribbed	2 1 1/4	1 1/16	4 3/8	2570	28
10. Slag wool, sectional	2 1 1/4	1 1/16	5 1/4	3230	28
11. Asbestos rope filled with slag wool	2 1	1	4 1/4	1870	31
12. Mica flexible, thick	2 1 1/2	2	6 3/8	6020	32
13. Cresswell's asbestos, plastic, No. 2	2 1	1	4 3/8	2550	36
14. Mica sectional, double	2 2	2	6 3/8	7800	41
15. Cresswell's asbestos, plastic, No. 1	2 1	1	4 3/8	2950	42
16. Bennett-Lawes' plastic	2 1	1	4 3/8	2990	42
17. Asbestos rope filled with asbestos fibre	1 6 only	1 1/8	4 5/8	2620	45
18. Leroy's asbestos, plastic	2 1	1	4 3/8	3300	47
19. Plastic slag wool	2 0	1 1/4	5 3/8	6450	56

NOTE—In cases where two different thicknesses of material have been experimented with, the results are only given with the thicker covering.

Railway Men in Convention at Saratoga Springs, N. Y.

The Master Car Builders' Association held its thirty-eighth annual convention at Saratoga Springs, N. Y., June 22, 23 and 24. Headquarters were established at the Grand Union Hotel. The following programme was announced:

WEDNESDAY, JUNE 22, 10 A. M.

Prayer; president's address; reports of secretary and treasurer; assessments and announcement of annual dues, appointments of committees on correspondence, resolutions, nominations, obituaries, etc.; election of auditing committee; unfinished business; new business; discussion of reports: standards and recommended practice; triple valve tests; brake-shoe tests; tests of M. C. B. couplers.

WEDNESDAY, JUNE 22, 7.30 P. M.

Topical discussions:

"What are the advantages or disadvantages of two-inch main steam pipe with one and five-eighths inch steam hose." Discussion to be opened by Mr. J. J. Hennessey.

"Advisability of the Master Car Builders' Association adopting standard contour lines for steam hose couplings, with a view of having same interchangeable upon the same principle as the M. C. B. coupler contour lines." To be opened by Mr. M. T. W. Demarest.

"To what extent does friction draught gear reduce repair, expenses, etc." To be opened by Mr. E. B. Gilbert.

Discussion of reports: standard location of third rail for electrical operation; stenciling cars; coupling chains.

THURSDAY, JUNE 23, 9 A. M.

Discussion of reports: draught gear; stake pockets; best preventive of rust on steel cars; rules of interchange, including report of arbitration committee on prices for repairs of steel cars; outside dimension of box cars; the use of steel in passenger car construction; cast-iron wheels.

THURSDAY, JUNE 23, 3 P. M.

Topical discussions:

"To what extent will a more rigid inspection of car couplings at terminal points reduce accidents and repairs." To be opened by Mr. James Macbeth.

"The advantages and disadvantages of the different varieties of side bearings now in use." To be opened by Mr. L. H. Turner.

"Can not the present method of securing spring pockets to couplers for freight cars be improved upon?" To be opened by Mr. J. S. Lentz.

"Brake beams. The proper hanging of brake beams to secure brake-shoe clearance." To be opened by Mr. W. E. Fowler.

"Stronger draught gear for passenger cars. Wherein should present practice be modified?" To be opened by Mr. H. La Rue.

FRIDAY, JUNE 24, 9 A. M.

Discussion of reports: air-brake hose; rules for loading long materials; steam and air line connections; tank cars; conference with interstate commerce commission; subjects.

Reports of committees on correspondence, resolutions, etc.

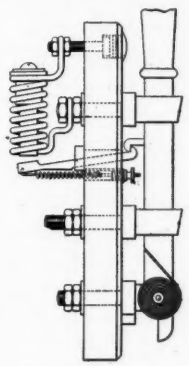
Election of officers.

The American Railway Master Mechanics' Association will also hold a meeting at the same place and date.

The American Railway Accountants' Association will hold a session at Saratoga Springs, N. Y., June 29.

Electrical Patents.

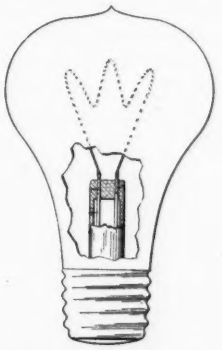
The Stanley Electric Manufacturing Company is the assignee of a patent recently granted to Mr. William J. Lloyd, of Pittsfield, Mass., on an improvement in circuit-breakers. The invention relates to circuit-breakers especially adapted for use on street cars. In practice the circuit-breakers on street cars are placed in many different positions, as is found convenient.



CIRCUIT-BREAKER.

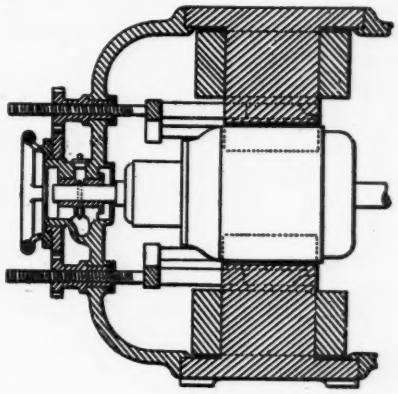
With circuit-breakers as ordinarily constructed, a change in position affects the setting of the tripping device, thereby changing the opening point of the breaker. In the present invention a circuit-breaker is provided which may be calibrated for any position and which will not have its opening point changed by any alteration of its position. This is accomplished by providing a balanced armature for the tripping device. The use of a balanced armature necessitates the employment of a spring for the retractive force. The spring is so arranged that the retractive force on the armature as it is drawn up is not increased and a hammer blow is obtained.

An incandescent lamp has recently been patented by Mr. Samuel E. Doane, of Cleveland, Ohio, and the patent obtained thereon assigned to the National Electric Lamp Company, a corporation of New Jersey. The object of the invention is to permit the use of less expensive wire as the leading-in wires of incandescent lamps. It has been the practice to employ solid platinum wire for the leading-in wires of these lamps, because of its non-oxidizable quality and also because its coefficient of expansion is the same as that of glass. Certain metals have their coefficient of expansion substantially the same as that of glass, but these metals oxidize easily. When such metals do oxidize, air will leak in between the glass and the oxidized surface of the wire into the bulb and thus destroy the vacuum therein. If one coats such a wire, as by electroplating, with a thin skin or shell of non-oxidizable metal, as gold, and then seals one or both ends of the short sections of the wire by fusion, such sections may be successfully used as the lead-in wires of incandescent lamps and analogous structures. The metal is thus prevented from oxidizing, or, if it should become oxidized, the oxidized air could not, because of the seal, get between the oxidized surface of the core and the non-oxidizable coating. Sometimes the core metal in being drawn into wire is not perfectly cylindrical, but, on the contrary, has a crease or fold longitudinally. If such a wire were electroplated with gold and its ends not sealed, air could leak between the gold coating and the core through this longitudinal crease, but if the ends of the wire are sealed by fusion, such leakage can not take place. Another kind of coated wire may also be used, namely, a drawn wire having a metal core and a platinum shell. By fusing, and thereby sealing one or both ends of short sections of this wire, leakage of air between the shell and core is prevented and such short sections may be used as the leading-in wires. The present invention is adapted for use with either type of wire above referred to, and consists in the employment as the leading-in wires of incandescent lamps and analogous devices, of wire having a metallic core and a non-oxidizable coating, and having one or both of its ends sealed by fusion. It also consists of an incandescent lamp in which such leading-in wires are employed.



INCANDESCENT LAMP.

An improvement in continuous-current dynamos has been recently made by Emile J. Javauz and Alfred M. L. Barbou, of Paris, France. The object of the invention is to provide means for controlling the magnetic resistance of the magnetic circuits by means of thin bars or rods of iron adapted to be displaced parallel to the armature axis in holes or grooves formed in the pole-pieces in direct proximity to the bore. By this means the strength of the magnetic flux can be altered and consequently the inductive reaction, so that the speed of the machine can be altered within wide limits. The pole-pieces of the dynamo are provided with apertures in such a manner that the section of passage for the magnetic flux is considerably reduced. The apertures are arranged in close proximity to the bore and extend from one side of the pole-pieces to the other. Iron bars of the same shape as the holes are adapted to slide with slight friction therein. According to the extent to which these iron bars are inserted in the apertures, the section of passage for the magnetic flux is increased or reduced and the magnetic resistance consequently altered. The insertion of the bars into the pole-pieces can be effected by hand or automatically. In the former case they are simultaneously displaced by means of a hand-wheel. Means driven by the dynamo shaft can be employed if desired for automatic adjustment for the purpose of maintaining a constant electromotive force in the case of a dynamo driven at variable speed. By this means the insertion of the bars into the pole-pieces is automatically regulated, thus increasing or decreasing the electromotive force as may be necessary.



CONTINUOUS-CURRENT DYNAMO.

Mr. George F. Atwood, of Wakefield, Mass., has assigned to the Primary Power Company, of the same place, a patent recently obtained by him on exciting fluid for electrical batteries. The composition is especially adapted for use in batteries of the Bunsen type. The electrode immersed in the composition is preferably zinc. In preparing the solution, Mr. Atwood adds to thirty gallons of water sufficient sulphuric acid for its specific gravity to be 1.2. After cooling, one and one-half pounds of ammonium carbonate, ten ounces of carbonate of sodium, and ten ounces of bisulphate of mercury are mixed therewith. The solution is then diluted with six parts of water and is then ready for use.

Reviews of Current Engineering and Scientific Literature.

Protection of Electric Railway Grade Crossings.

A system of protecting electric railway grade crossings has been devised by M. Carbonnelle, of Uccle, Belgium. The system operates by cutting out that section of the live conductor at the crossings, except when a car is upon it. When a car is passing a crossing, it automatically cuts and connects this section of the conductor to the feeder. The device consists of two relays, one operated by an alternating current supplied from the car. The closing of this relay actuates the second relay, which closes the main circuit, and which is then held in place until the car leaves the section. The circuit for the first relay contains a condenser, thus preventing direct currents from passing; but as this circuit is thrown out as soon as a section of conductor is connected to the main feeder, the second or locking relay is necessary. The current required to operate the first relay is supplied by means of a common magneto operated by the motorman.—*Translated and abstracted from Electro (Brussels), April.*

The Effect of the Selenium Cell on Photographic Plates.

In the *Physikalische Zeitschrift,* No. 5, 1904, M. J. J. Taudin Chabot described some phenomena which he had noticed when experimenting with a selenium cell. He found that these affected photographic plates, and he suggested that the action might be due to a new ray or a new emanation. In this article Herr G. Berndt describes an investigation which he has carried on with a view of verifying or disproving these suggestions. He used in this work his carbon cell, but he adopted certain precautions which were not observed by M. Chabot. The latter had found that when an electric current was passed through a selenium cell it affected a photographic plate so that a sheet of aluminum gave a clear silhouette. Herr Berndt thought that this result might be due to chemical action, on account of the contact of the cell, the aluminum and the photographic plate. He therefore separated all three by air spaces. Before the experiment, the cells—two of which were used—were kept for a long time in a dark room. They were then placed over the plate and allowed to stand for 172 hours. One of the cells was inactive; through the other a small current was passed. Upon developing the plates, no trace of an effect was shown. Although the current used in this experiment was much less than that used by M. Chabot, the failure to observe a darkening of the plate can not be attributed to this, since, in any case, a slight effect should be noticeable. In fact, M. Chabot says that the passage of the current is not necessary for the action.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), June 1.*

Benzine Fires.

It has been known for some time that benzine is apt to ignite spontaneously in chemical cleaning works, at the moment when woolen materials are pulled out of the benzine wash. It was obvious that the ignition was caused by electric sparks. The fires were more frequent in the coldest weather, and more frequent in dry, pure air than in damp, dusty air. The phenomena were investigated twelve years ago by M. M. Richter. Previous to this no remedy was known. Richter, by simple experiments, showed that electric sparks caused the trouble, and he found that with dry air and a temperature of minus fifteen degrees centigrade, the danger was greatest. He discovered that when 0.02 per cent of magnesium oleate was added to the benzine, no discharges took place and no explosion occurred. The reason for this was not fully understood until it was explained by recent work of Herr G. Just, of the technical high school of Karlsruhe. Just first attributed the effect to a lowering of the dielectric constant of the benzine, due to the presence of the oleate, but he found that this was not the case. The conductivity of the benzine and the mixture seemed at first to afford no explanation, as pure benzine is practically an insulator, and the addition of 0.05 per cent of magnesium oleate raised the conductivity only from 2×10^{-12} to 1.3×10^{-10}. However, this increase in the conductivity is sufficient to prevent the accumulation of dangerous charges, as was shown clearly by means of an electroscope, which when connected to two electrodes immersed in benzine showed that the charge was retained for some minutes. When the electrodes were placed in the oleate solution it was found impossible to impart a charge to them. Other preparations were tried in place of magnesium oleate, but none were found as satisfactory. Benzine is a poor solvent for compounds which a textile chemist could accept.—*Abstracted from Engineering (London), June 3.*

A Criticism on Single-Phase Traction.

In this communication Mr. E. Kilburn Scott criticises the several methods of single-phase traction which have been put forward. He expresses little faith in the Ward Leonard system, as the locomotive is too complicated. He does not see that the Oerlikon collecting device is much of an improvement, since the adjusting of this to the widely varying positions of a trolley wire would be likely to cause trouble. Mr. Scott says that his own investigations lead him to the opinion that the recent improvements in single-phase motors offer very little hope for single-phase traction. He anticipates commutator troubles in these motors, because the short-circuited coils under the brushes act temporarily as the secondary of a transformer. During running this does not give trouble, as the short-circuited coil is changing continually; but in starting a train on an incline, with the brakes down, if the current is switched on before they are released, or if the train does not start immediately, owing to the tractive resistance, then the short-circuited coils are almost certain to be burned out. The use of resistances in the windings is being tried, but he does not think it will be possible to use very large resistances, since these would increase the dimensions of the motor and lower the efficiency. Another objection to the single-phase motor is the question of torque. In a continuous-current motor the torque is constant under constant load, and there is no pulsation. In a three-phase motor the torque is nearly constant. With a single-phase motor the torque varies from zero to a maximum, and back to zero, with every complete alternation. This means that, for a certain freight train requiring a maximum drawbar pull of ten tons, which, with a continuous or three-phase motor would require a locomotive weighing fifty tons, the latter must weigh 85 or 100 tons, if equipped with single-phase motors. Mr. Scott also calls attention to the disadvantage of the single-phase motor, in that it is more expensive and heavier than a poly-

phase motor of equal power. He also thinks that the objection to three wires for a three-phase system has been exaggerated. Once bare wires are allowed, a wire or two more makes no difference. Moreover, assuming that a system requires a certain amount of copper, the more copper leads put into bare wires overhead, the less copper will be required in insulated feeders underground. It is the latter which cost.—*Abstracted from the Electrician (London), June 3.*

The Repulsion Motor.

In this section of a serial which takes up at considerable length the theory of the repulsion motor, Mr. F. W. Carter mentions some of the chief characteristics of this machine. The motor possesses the drooping characteristic of the successful railway motor. With the constant terminal voltage, the speed is low and the resisting torque is great, and rises continually as the resistance diminishes. Synchronism is not the singular speed of this motor. It is capable of passing through this speed and running away if the counter-torque be sufficiently reduced. Whether or not the motor can be started from rest with full voltage on the terminals depends on what it has been designed to stand. With a good resisting torque, the speed can be varied as in the continuous-current railway motor, by variation in the terminal voltage. With two motors, two speeds can be obtained, corresponding to series and parallel running. It is possible to run economically at other speeds by means of a compensator. The speed can also be varied by shifting the brushes, being generally diminished as the short-circuited coil is moved further and further from the centre of the field poles. Thus, fractional speed-running with this motor does not involve the waste of energy that attends the running of continuous-current railway motors on resistance points. An apparent objection to the repulsion motor lies in the fact that to reverse the direction of rotation it is necessary to shift the brushes with reference to the field from one side to the other of the pole centre. In the case of the repulsion motor, however, the stator winding is distributed, thus making it easy to move the field pole, which accomplishes the same purpose. In the Latour and Winter-Eichberg modifications of the repulsion motor, the pole is shifted electrically to the required position. The auxiliary current is introduced into the armature, producing a cross field, which, compounded with the main field, gives a suitably situated resultant.—*Abstracted from the Electrical Review (London), June 3.*

Power Development Works at Niagara Falls, Ontario.

This article gives an idea of the progress which has been made by the Canadian companies which are developing the power of the Canadian falls. The Ontario Power Company, which is building a large forebay above the Dufferin Islands, and from which water will be conducted in eighteen-foot pipes to a power-house placed in the gorge below the falls, has nearly finished the concrete retaining-walls. The excavation of the rock, which constitutes the greater part of the work in connection with the 200,000-horse-power intake, is also nearly complete. The buildings to house the screen and gate mechanisms are about to be begun, and these will be completed during the summer. Half of the 6,600 feet of main feeder pipe, eighteen feet in diameter, has been laid in the trench previously excavated in Victoria Falls park. Tunnels for four penstocks of 40,000 horse-power are completed. The work on the generating station is progressing rapidly. The shortness of the period during which work can be carried on at this point, adjacent to the foot of the Horseshoe falls, requires that construction proceed with despatch. It is expected that this portion of the work will be completed before winter conditions set in. The Canadian Niagara Power Company, which is building a station similar to power-house No. 2 of the Niagara Falls Power Company, has just completed the tunnel tail-race, which is 2,200 feet long. This tunnel is of the horseshoe form, twenty-five feet high and nineteen feet wide, and is lined with seventeen inches of concrete, with a vitrified brick facing. The grade of the tunnel is seven feet per thousand, which will give a speed of water, when in full operation, of twenty-seven feet per second. Considerable progress has been made in excavating the wheel-pit and the forebay. The former is 165 feet deep, eighteen feet wide inside the brick lining, and 570 feet long. The head canal to the forebay is fifteen feet deep and 250 feet wide. The forebay itself is 600 feet wide, extending the whole length of the power-house. Elaborate provisions have been made to protect the wheels from ice. The power-house, the first section of which will contain five 10,000-horse-power units, is being constructed of Queenston limestone, roofed with tile. Underground conduits are being constructed from the power-house to Upper Arch bridge. These will have a capacity of 75,000 horse-power. The transformer house, equipped with water-cooled transformers, has been constructed with a present capacity of 25,000 horse-power. The Electrical Development Company, which is building a power-house at the shore line, with elaborate intake works and a tunnel excavated under the river, is about to commence the construction of the power-house. The building will be 500 feet by 70 feet, with an elevation forty feet in height. Plans for this power-house call for eleven generating units of 12,500 horse-power each.—*Abstracted from the Canadian Electrical News (Montreal), June.*

The Electric Arc between Mercury and Carbon.

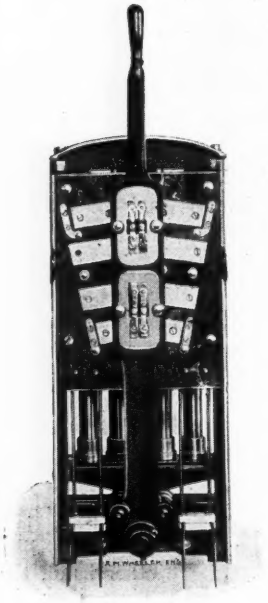
The electric arc between mercury and carbon has been studied by Herr L. Cassuto. The arc was formed within a glass vessel of cylindrical form, with the axis vertical. Mercury was placed at the bottom, and a carbon rod introduced from above. The entire vessel was enclosed in a second one, through which water was circulated for cooling. Measurements of current and voltage were made for different arc lengths and for different directions of current, and the results are given in graphical form. They show that, for equal current strengths and equal separation of electrodes, the electrode potential of the arc is greater when the mercury forms the cathode and the carbon the anode, than for the reverse. Assuming as the first approximation that the equation for the fall of potential has the form $B = C + g\,l$, it is found that the constant C, which is the sum of the anode and cathode potential drops, is approximately the same for either direction of current. On the other hand, the fall of potential g in the arc itself is greater when the mercury forms the cathode than when it forms the anode. This dependence of the potential fall in the arc is explained in the following way: the arc shows for its entire length the characteristic blue light of mercury vapor, independently of the direction of the current. This shows that the mercury is vaporized when it forms the cathode, as well as when it is the anode, more strongly than the solid carbon. But this vaporization is greater from the mercury anode than from the mercury cathode, since the fall of potential of the former is greater than that of the latter. The arc from a mercury anode therefore contains more vapor than one from a mercury cathode. The potential fall along the arc depends upon the mixture of vapors, increasing as these decrease; consequently, it will be less for the more strongly vaporized mercury anode. The same subject has been investigated by Mr. J. E. Ives, and his results are here quoted. Mr. Ives's work was carried out by striking an arc between mercury and a solid metal, the electric circuit containing a large inductance. The resulting spark was then absorbed by connecting the condensers across the arc. These results are in agreement with the explanation just given.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), May 15.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Allen-Bradley Controller.

Users of rheostats and other electric current controlling devices will be interested in the new Allen-Bradley controller manufactured by the American Electric Fuse Company, of Chicago, Ill. This machine is claimed to be absolutely free from sparking, welding or arcing, and to require no repairs or renewals of its parts whatever, except when accidentally injured from external causes.

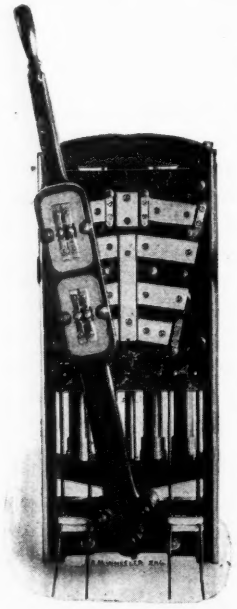


FRONT VIEW, BEFORE STARTING.

The American Electric Fuse Company states that before closing its contract with the owners of the Allen-Bradley patents, it made a thorough test of the controllers and became convinced that it could guarantee satisfactory operation and freedom from breakdowns or interruptions of service. A year's guarantee is given upon each controller sold, and in addition, every customer is granted the privilege of three months' trial free, the controller to be returned at the end of that time if not satisfactory to the user.

The Allen-Bradley controller is a carbon resistance machine. The resistance medium is a column or pile of carbon buttons or discs placed inside a non-combustible, insulating tube, which in turn is enclosed within an external tube or shield. The resistance of such a column of carbon, made up of a number of discs, resting upon each other with no other pressure than that of their own weight, is naturally very great.

When an electrical connection is made between the top and bottom carbons of the column, the flow of current through all of the intervening carbons will meet with a very high resistance, due to imperfect contacts between the several carbon discs. To reduce this resistance, a compression lever, operating in connection with springs, is employed to press the carbon discs together, thereby making the contacts between them perfect. This compression is gradually applied, affording infinite control and gradation of the resistance. When the compression is released from the column of carbon, the carbons, with their own natural elasticity, expand to their normal condition and the resistance of the column of carbon again becomes very great, the contacts between the carbon discs no longer being perfect.



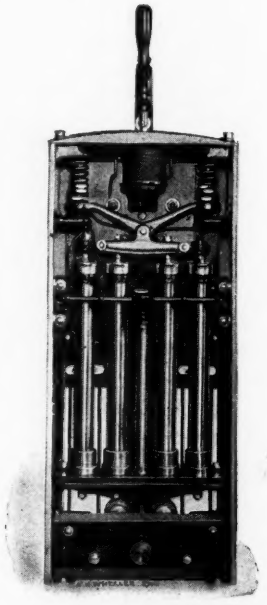
FRONT VIEW, ALL RESISTANCE OUT.

Any desired resistance may be had by increasing the number of tubes or columns employed in the controller. A simple mechanical adjustment of the operating parts equalizes the compression upon all the tubes in the controller, as shown in the illustration, of a controller having four tubes.

Among other points of merit in these controllers the following are especially claimed:

"It has no steps or contact points, therefore the current is not regulated by jerks; and the controller itself is absolutely free from sparking, welding and arcing.

"There is no limit to the control of the current flow, and the motor can be driven as fast or as slow as desired with perfect control and infinite gradation of resistance, and without the least danger of injury to the motor itself, or to the controller.



REAR VIEW, BEFORE STARTING.

"The resistance units are not endangered by heat even when the full resistance is left in the circuit for long successive periods of time.

"The compactness of the Allen-Bradley controller is another point in its favor. Controllers up to forty horse-power do not exceed ten inches in width.

"A point of special interest to the practical operator of electric cranes, is the ease with which the Allen-Bradley controller is operated."

The carbons are protected from injury or destruction through heat by being excluded from the air. The manufacturer states positively that there is no change in their resistance after once having been heated.

The Allen-Bradley controllers are made to operate with any standard motor and are built in all standard sizes.

High-Speed Motor-Driven Pumps.

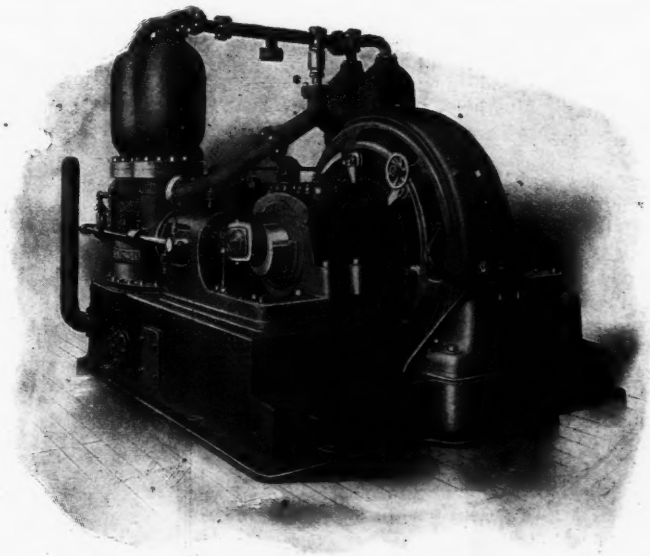
Of late there has been considerable controversy over the relative efficiencies of mine pumps operated by compressed air and electricity. Where a long line of piping is necessary, the use of steam has, in some cases, been condemned, because of the loss by condensation and other inherent difficulties. There have also been difficulties in the way of adapting electricity to driving pumps, due, in some cases, to the necessity for speed gearing. The Blake & Knowles Steam Pump Works, 114 Liberty street, New York city, has placed on the market a high-speed motor-driven pump which is designed to eliminate the alleged difficulties of toothed gears in connection with motor-driven pumps. In the machine illustrated herewith, the pump plungers have been connected to cranks mounted directly upon the shaft of the motor. This pump has a capacity of about 250 gallons per minute, against 1,000 feet head, when running at a speed of about 300 revolutions per minute. The manufacturer claims, due to the careful designing of the internal parts of the pump, a mechanical efficiency of over ninety-three per cent.

The pump is of the duplex type, the cranks at the opposite ends of the motor shaft being set at right angles to each other. The plungers are of the outside packed pattern, and the two plungers of each pump are connected by side rods. The plungers are three and one-half inches in diameter and have a stroke of five and one-half inches. In a carefully conducted test, particulars of which are given in the following table, the pump proved successful in every way, and, it is said, surpassed the expectations of even the builder.

The volume of water pumped was measured by means of a carefully constructed and calibrated Freeman nozzle, and all gauges were tested before and after the test by means of a weight-gauge tester. The pressure at the nozzle was measured by a column of mercury connected to a piezometer chamber. Under the greatest pressure the pump showed a high volumetric efficiency. The operation was practically noiseless under all conditions, and was unaccompanied by shock or heating.

TEST OF BLAKE-KNOWLES, HIGH-SPEED DUPLEX PUMP, THREE AND ONE-HALF INCH PLUNGERS, FIVE AND ONE-HALF INCH STROKE, DIRECT-CONNECTED TO A GENERAL ELECTRIC, 100-HORSE-POWER, SIX-POLE, 200-VOLT SHUNT MOTOR.

Revolutions per Minute.	Motor Input. Watts.	Pumps. Gallons Delivered.	Pumps. Pressure. Lbs.	Pump. H. P.	Motor. Pump.	Efficiencies. Motor Alone.	Efficiencies. Pump Alone.
					Per Cent.	Per Cent.	Per Cent.
280	28,800	237	110	32.63	78.0	86.5	90.1
280	40,600	237	215	48.94	82.2	89.0	92.36
280	52,550	235	321	62.25	84.4	90.1	93.66
280	60,200	234	425	74 53	84.3	90.9	92.74
309	58,800	232	496	71.79	83.3	....	.....



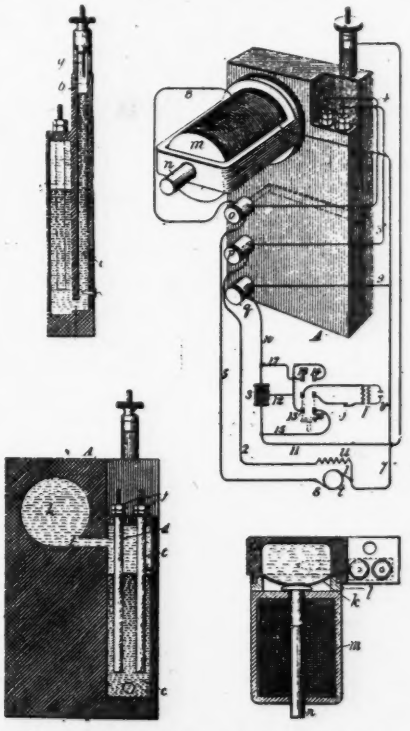
HIGH-SPEED MOTOR-DRIVEN PUMP.

The pump and motor are mounted upon a rigid box girder frame, and the unit is self-contained and occupies a relatively small space.

These pumps are built in capacities from 200 to 4,000 gallons per minute, and for heads varying from 100 to 2,000 feet. One of these pumps, operated by a direct-current motor, is being exhibited in the space of the General Electric Company, at the St. Louis Exposition.

An Improved Potential Regulator for Charging Storage Batteries.

A simple regulating device has been invented by M. Alexis Le Blanc for controlling the potential of a dynamo when used in charging storage batteries. The regulator consists of a block of insulating material, such as hard rubber, having cut in it two vertical chambers. Into one of these two carbon resistance rods are attached in a vertical position, these reaching nearly to the bottom. Into the other a short metallic electrode is inserted at the top. These two chambers are partially filled with mercury, and there is an opening connecting the two at the bottom. A third chamber is cut into the insulating block near the top, and by means of an opening, this communicates with the upper part of the chamber, which contains the resistance carbons. This third chamber and the space above the mercury and the one connected to it are filled with water,



POTENTIAL REGULATOR FOR CHARGING STORAGE BATTERIES.

the side of the former being closed by a flexible diaphragm. Against this diaphragm presses a piston, which is acted upon by the core of a solenoid. The winding of the latter is connected across the brushes of the machine which is to be regulated. The device operates in the following way: the charging circuit from the dynamo passes through the mercury and through the metallic electrode mentioned above. In the field circuit of the dynamo the two carbon resistances are connected. When the potential of the generator is below that necessary for charging, the level of the mercury in the regulator is below the metallic electrode; hence, the charging circuit is open. As the potential of the generator rises, the current through the solenoid increases; and hence, the force with which the piston attached to its core presses against the diaphragm. This, acting through the water, presses down the level of the mercury in the resistance chamber, raising it in the other, until the charging circuit is closed. This motion of the mercury also increases the resistance in the field circuit by increasing the length of the path through the carbon rods. When properly adjusted, the apparatus maintains a constant potential, and opens the charging circuit whenever the voltage is less than that sufficient to charge the batteries.

The Canadian Westinghouse Company, Limited.

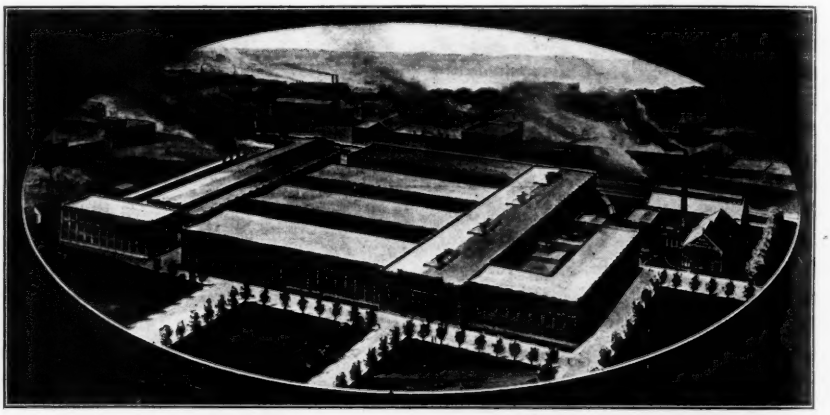
A highly interesting manufacturing installation is the new plant under construction at Hamilton, Ontario, for the manufacture of the well-known types of electrical appliances of the Westinghouse Electric and Manufacturing Company. From the time when electrical apparatus was first made use of in Canada, the Westinghouse Electric and Manufacturing Company, of Pittsburg, has furnished a large and increasing portion of this apparatus in the Dominion, until the time has arrived when it has been found advisable to establish a distinctively Canadian factory to secure that intimacy of relation which is advantageous alike to the manufacturer and client.

Passing in review the various sites suitable for the location of such a factory, it was natural that the choice should fall on Hamilton, not only from the natural advantages of that city from the standpoint of a manufacturer, but as well from the fact that for a term of eight years another Westinghouse interest, the Westinghouse Manufacturing Company, Limited, has been located in that centre, engaged with marked success in the manufacture of Westinghouse air brakes for the equipment of Canadian rolling stock.

To join under one management the existing air brake business and the electric business to be instituted, a new organization was formed under the name of the Canadian Westinghouse Company, Limited, and, leaving the air brake factory in its present state of efficient equipment, work was at once started to provide a modern plant for the manufacture of electrical apparatus. Notwithstanding an unusually severe winter, construction work has been pressed throughout, until at present writing it is announced that an operative condition of the plant will be reached this fall.

The Canadian company will operate under the enjoyment of an agreement with the Pittsburg companies, by which all designs and processes of the older companies will be at its disposal.

The lines of manufacture to be taken up comprise alternating and direct-current generators; alternating and direct-current motors, including railway motors, controllers, transformers, switchboards, and switches, rheostats, instruments, meters, arc lamps, and various subsidiary apparatus included in the general line of Westinghouse equipment.



BIRD'S-EYE VIEW OF THE WORKS OF THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, HAMILTON, ONTARIO.

The new buildings provided consist of foundry, pattern shop, pattern storage, general machine shop, detail machine shop, warehouse, insulation treating building, boiler house and transformer building. On the diagram of the property shown in the illustration, these are lettered from "A" to "L," inclusive, in the order just recited, "L" is the brake plant and "K" the office building, enlarged to accommodate the increased force of the new company.

In laying out the manufacturing buildings on the property two cardinal points were kept in view—the first, that progress of material from raw to completed state should, as far as possible, be in a continuous direction; and the second, that the plan adopted should lend itself to an initial installation which would constitute a complete unit, and also be capable of reproduction along its own lines to an extent limited only by the total available property. On the latter point it may be said that something less than half of the total installation shown in the illustration is at present under construction. The northern half of the foundry and warehouse, along with the corresponding machine shop wings, being left for future extensions. Regarding progress of material through the plant, it may be pointed out that with raw material received on the track west of the foundry, progress is in general from this point to the warehouse, from which all shipments are to be made over tracks conveniently located within the building for this purpose.

The foundry is of monitor roof construction, with middle and two side bays. In the west bay are located the cupola house, the core room, and the brass floor, while just outside, along the west wall, are located the bins for pig, sand, limestone, etc.; a portion of the east bay is separated by a partition from the foundry space to serve as a blacksmith shop. The main bay is served by a twenty-ton crane, the length of the building being also traversed by traveling jib cranes, operating at a lower level. A mezzanine floor over a portion of the core room provides suitable toilet facilities without reducing productive floor space. An electrically driven elevator is provided to deliver iron from the yard to the charging floor and a coke conveyer, also electrically driven, receives coke from the railroad cars and deposits it in an appropriate bin on the charging floor.

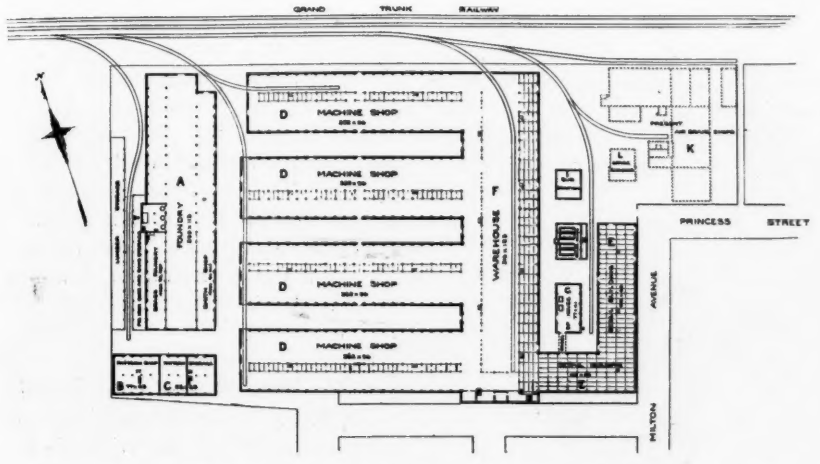
The pattern shop, located near the foundry, is three stories in height, besides a basement to accommodate shafting

for machinery on the first floor. The first floor is devoted to carpenter and cabinet-shop uses, while the second and third floors are for pattern making. An electric elevator serves this building from the basement to the top floor. The pattern storage building, adjoining, is similar in construction, except the basement, which in this case is unnecessary.

The general machine shop is arranged with a high bay covered by a twenty-ton crane and a low bay with a five-ton crane. In the former the heavier machine tools are located and it is here that mainly the stationary parts of generators and motors will be finished, while the low bay will be devoted to the preparation of rotary parts, the gallery floor above the latter will provide space for the manufacture of commutators, brushholders, bearings, etc., also for the tool room and controller department. Toilet rooms and heating and ventilating fans are placed on a narrow mezzanine floor between the high and low bays, these being reached by stairways from both the ground and gallery floors. The elevators also pass up through this floor and industrial tracks run under the mezzanine, along by the foot of the elevators on the ground floor.

After the completed rotary part has received its winding at the eastern end of the low bay it is passed by a jib crane under the mezzanine floor at this point on to the eastern end of the high bay, where it is placed in its corresponding stationary part, which has been under construction in this aisle, and the auxiliary parts are received at the same point by the elevator from the gallery floor. In addition to the crane serving the main portion of the high bay, this eastern end or assembling floor is provided with an additional crane of like span, but at a lower level, so that by it machines can be delivered from the assembling floor, through under the west gallery of the warehouse into the middle bay of latter building, where the north and south crane can pick up the load for further handling.

The warehouse has a high bay in the middle, with one gallery on the west side and two galleries on the east side. The machines delivered, as just described, from the general machine shop, are passed from the testing floor on the west side of the main bay and after tests are finished are painted and shipped on cars from the warehouse track. This track also is the means for entry into the plant of the less bulky material and supplies, which are stored in this building for ready distribution to both the general and detail machine shops. The floor east of the tracks is at car floor level to facilitate handling of such material, and elevators are, of course, provided for distributing to the various floors.



GROUND PLAN OF THE WORKS OF THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, HAMILTON, ONTARIO.

The detail machine shop has two floors throughout, besides the ground floor at levels corresponding to the two galleries on the east side of the warehouse, with which they directly communicate. It should also be noticed that the top floor of this building is at the same height as the gallery in the general machine shop and the west side of the warehouse, and that a connection gallery at the same height is carried around the south end of the warehouse building. On the ground floor of the detail machine shop the coil winding and insulating departments are located, this being convenient both for reception of wires from the warehouse and delivery of completed coils to the winding and assembling spans at east end of the general machine shop already referred to. The second floor is devoted to the machine work necessary on switches, rheostats, meters, instruments, arc lamps, etc., and on the third floor are the assembling and testing rooms for these lines of apparatus. No cranes are needed in this building, but elevators are provided, securing easy access to various floors.

The insulation-treating building is separate from the main group so that this work, involving the use of inflammable materials, can be isolated. Convenient communication with the detail building is provided by a two-story enclosed bridge cut off at each end by fire-doors.

The boiler house is small in comparison with the main plant, which is due to the fact that the use of steam will be largely restricted to heating and drying purposes. Most of the steam for drying will be used in the insulation-treating building next adjoining, but for heating the building it will be piped to nests of coils suitably installed in each building, with fans to distribute the air heated by these coils.

Power for manufacturing and testing purposes, as well as for lighting, is to be obtained from the local electric power company, which draws its supply from De Cew Falls. Current will be received in the transformer house at 2,400 volts and distributed at 440 volts for general shop purposes, although lighting distribution will be at 110 volts, and transformation to direct current will be made to supply some of the cranes and tools.

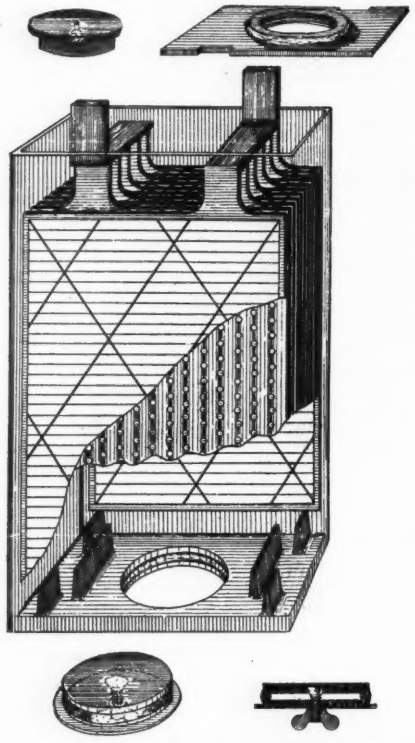
The construction of the buildings, which is in the hands of Westinghouse, Church, Kerr & Company, of New York, as engineers and general contractors, is of the most modern approved type. The foundations and walls up to the window sill line are of concrete, above which the walls are brick, laid up in cement mortar. Floors and roofs are of reenforced concrete throughout, and in the detail machine shop and pattern buildings the columns are of this construction. All roofs are practically flat, with drainage so arranged that the leaders are carried down through the interior of the buildings to avoid stoppage by freezing in cold weather. Floors are top dressed with one-inch maple and the roofs with tar and gravel.

Transportation between the foundry and all buildings, including the air brake plant, will be by industrial railway, operated by storage battery locomotive. The standard gauge tracks on the property are directly connected with the main line of the Grand Trunk Railway for reception of material and shipment of product. The main entrance to the plant for employés is at the south end of the warehouse building, a central point at which will be located time-checking devices, and from which stairways lead directly to the various floors. Entrances for teams from the city streets are provided near the west end of the machine shop and in front of the office building.

The equipment of the plant will be on modern approved lines, as developed by experience of the Pittsburg factories.

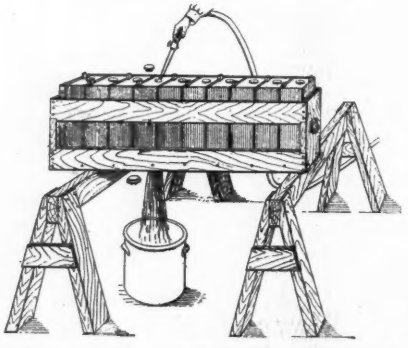
The Duntley Washable Battery Cell.

The Chicago Storage Battery Company, 1241-1243 State street, Chicago, Ill., has placed on the market a washable battery cell, the mechanical features of which are shown by the accompanying illustrations. In designing this cell, the aim has been



DETAILS OF THE DUNTLEY WASHABLE BATTERY CELL.

to make it easily possible to remove the sediment which is liable to accumulate, to the damage of the battery. In cleaning the Duntley washable battery cell, the tray is removed from the vehicle and placed on supports, as shown in the il-



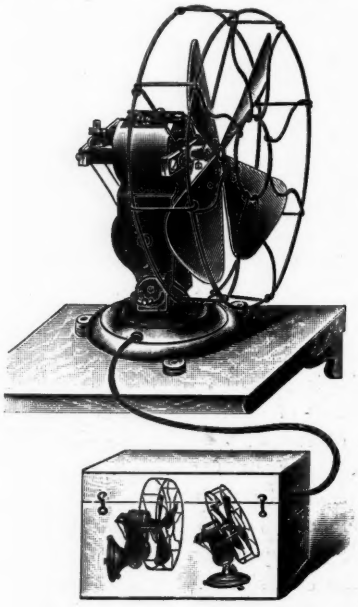
METHOD OF USING THE DUNTLEY WASHABLE BATTERY CELL.

lustration. The bottom plug is removed by unscrewing the thumb screw, permitting the electrolyte to flow into the waiting receptacle, which can then be removed. After the electrolyte has been strained to remove the sediment, or allowed to stand until the sediment settles, it can be used again repeatedly. The screw plug is removed from the top, and an ordinary garden hose inserted, when it is possible to wash the cell thoroughly. The bottom plug is then inserted and the filtered electrolyte poured through the opening in the top, the screw plug returned, and the cell again ready for service. This method makes it possible to keep the cell in perfect cleanliness and to remove all deleterious deposits without touching the grids; and the cleaning can be accomplished by the most inexperienced person, as well as by a skilled mechanic.

These cells are made in sizes suitable for every requirement, and are adapted to all conditions of service. The company will be pleased to send its catalogue, describing in detail the various applications of this cell.

A New Battery Fan Outfit.

The Ewing-Merkle Electric Company, St. Louis, Mo., has placed on the market a new battery fan outfit, an illustration of which is shown in the accompanying engraving. This fan, the company states,



BATTERY FAN OUTFIT.

is efficient, attractive and low-priced. It takes current from portable batteries, and is easily moved as occasion requires. The fan throws a good breeze directly forward. It can be tilted to any angle, either up or down, or made into a wall bracket.

The fan is operated by twenty cells of dry battery, and will run two or three hundred hours if used three or four hours per day. If worked continually, not allowing the batteries to recuperate, the length of life will be reduced. Where constant work is necessary, as in a sick room, it will be more economical to alternate with extra sets of batteries.

The containing box is wired complete, has a switch to open the multiple connections, and a diagram is furnished showing how to put in the cells and connect them up. The weight of the outfit is four and one-half pounds, and boxed complete, eight pounds.

An Enclosed Removable Fuse for Moderate Potentials.

An enclosed fuse suitable for moderate potentials up to 1,000 volts is being exhibited by E. J. Belliol & J. Reiss in the French section of the Palace of Electricity, Louisiana Purchase Exposition. The fuse consists of a tube of insulating material, such as fibre. Through this the fuse wire is placed, and is then packed around with magnesium or other infusible powder. Connection is made at the ends by means of a spring cap, this firmly clamping the projecting ends of the wire and making good connection. The fuse is held in place by spring clips, and is easily removable and easily placed in position. The advantages claimed by the makers for this fuse are: it is safe; it operates without noise, even on short-circuit; it can be removed and returned to a live circuit without danger, and it is very economical.

Electric Fans in New York Theatres.

Mr. F. F. Proctor, the well-known theatrical manager and playwright, is a believer in the electric fan for the promotion of comfort during the heated season. All of the Proctor theatres have been designed or reconstructed with special reference to an all-year-round season. Electric fans of large diameter are continually exhausting the heated and vitiated atmosphere, replacing it with currents of fresh air drawn from the roof and cooled before being introduced into the auditorium. The temperature in various parts of the house is recorded upon the dials of automatic thermometers.

Annual Field Day.

The annual dinner, outing and field day of the Rhode Island No. 2 National Association of Stationary Engineers will be held at the Hauterieve Club grounds, Pawtucket, R. I., July 17, 1904. The party will assemble at the Hotel Narragansett, Providence, R. I., at 9 A. M. An informal reception will be held from 9 to 10.30 o'clock. Special electric cars will leave from the front of the hotel, on Dorrence street, at 10.30 o'clock for the club grounds.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TARIFF ON WIRELESS TELEGRAPH MESSAGES—A royal decree, just signed by the King of Italy, approves the new tariff for Marconi wireless telegraph messages. The cost from Italy to America is fixed at twelve and one-half cents per word.

CALIFORNIA COMPANY TO ORDER A LARGE BOND ISSUE—It is likely that the directors of the Los Angeles Gas and Electric Company will order a bond issue of $4,000,000, the funds to be used for retiring the floating indebtedness, and for making such improvements as may be necessary from time to time.

TROLLEY LINE IN YOSEMITE PARK—San Francisco and San Jose capitalists have been granted a franchise by Secretary of the Interior Hitchcock to build an electric railway into the Yosemite national park. This is the first franchise granted by the government for an electric road into any government reservation. The road will begin at Merced, and running north to the Merced river, will follow its windings into the valley. The terms of the franchise requires stations to be constructed every ten miles. It is announced that the work will be begun this summer. The time from Merced to the park over the road will be from five to six hours.

PENNSYLVANIA TRACTION PROPOSITION—The stockholders of the Monongahela & Washington Railroad Company and the Pittsburg, Virginia & Charleston Railway Company will meet on June 29, to act on a proposition to merge the former road into the latter. A meeting of the directors of the Pittsburg, Virginia & Charleston Railway Company has been held, and it was agreed to ask the stockholders for permission to acquire the Monongahela & Washington Company. The Monongahela & Washington Railroad lies in the southwestern section of Pennsylvania. It has connections with the Pittsburg, Virginia & Charleston Railway Company's system. It is the intention to purchase the stock of the Monongahela & Washington Company, and to acquire all its franchises, corporate property rights and credits.

MERGER OF POWER COMPANIES—A certificate of consolidation of the Rochester Gas and Electric Company and the Rochester Light and Power Company has been filed with the secretary of state at Albany, N. Y. The capital is $11,000,000, divided into 45,000 shares of preferred, and 65,000 shares of common stock. The preferred stock is to bear four per cent dividends for two years, and five per cent thereafter. The directors are Frederick Cook, Alexander M. Lindsay, Edward Bausch, Albert O. Finn, G. A. Hollister, Thomas W. Finucane, George W. Archer, Henry A. Strong, Eugene H. Satterlie and Albert H. Harris, of Rochester; Henry D. Waldbridge and A. G. Hodenoik, of New York city, and Edward W. Clark, Jr., and Clarence M. Clark, of Philadelphia, and James Richardson, of Providence, R. I.

MUNICIPAL SAVING BY CANAL WATER POWER—In response to a request from Chairman Bennett, of the Chicago (Ill.) finance committee, the following figures were furnished by City Electrician Ellicott: Street arc lamps in Chicago, 5,754; maintained by the city, 5,080; rented at $103 a year, 674; cost to maintain each city lamp, $54.50; cost of steam generation of light, $29; electrical expenses, $25.50. Mr. Ellicott figures that $10.25 fairly represents the cost of producing canal water power per horse-power. He would apply this to electric lights, and finds that the cost per light for generation of power would be, instead of $29 each, $10.25. During the day, when the arc lamps are not needed, it is the proposition of Commissioner Blocki, of the drainage board, to utilize the electric current to work the pumps and supply the city with water, in this way also saving considerable municipal expense.

SHASTA POWER COMPANY—The Shasta Power Company has been organized in San Francisco, Cal., and work will be commenced on a power plant in Redding County. The company has a capital stock of $1,000,000, and Mr. H. L. Shannon is president. Charles Jacobson and John W. Potts, of Redding, are on the board of directors, and they are also extensive shareholders. The other directors are E. Kingsbury and G. O'Brien, of San Franscisco. Work will begin at once on the water ditch and flume, and the installation of the power plant will follow. The plant will be located on Bear creek, and the water will be taken out of Hat creek. It will be carried by the ditch and pipe line to the power-house, where it is stated a sufficient fall can be obtained to generate 15,000 horse-power. A pole line will be run to Redding, and the people of that city will be supplied with light and power. Lines are also to be run to various parts of the county and into the mining sections.

EXTENSIONS OF INDEPENDENT TELEPHONE COMPANIES—The Western Telephone Company has been incorporated at Lincoln, Neb., with an authorized capital stock of $1,000,000, under the provision that $25,000 of stock shall be actually subscribed, and $18,000 paid up at the time of organization. The incorporators are Charles J. Bills, Mark Woods, George J. Woods, Frank H. Woods and Thomas Ewing. The company intends to construct long-distance lines to make connections with the independent system in Lincoln. One line has been constructed already, the wires running from Lincoln to Havelock, there to connect with the Plattsmouth company, which has run its wires to Lincoln. Five other long-distance lines are projected. One is to run to Nebraska City. Another runs through the southeast section of Nebraska, generally in the direction of Falls City. A third will run through Saline and Fillmore counties. Another will go in the direction of York, and another to Davey, where the Golden Rod system is already installed.

TELEPHONE AND TELEGRAPH.

FULTON, N. Y.—The erection of a telephone line between Fulton and Hannibal has been begun.

HILLYARD, WASH.—A new telephone line has been started to connect Spokane and Pleasant Prairie.

FORT WORTH, TEX.—The Fort Worth Telephone Company is putting in a line from Fort Worth to North Fort.

CROOKSTON, MINN.—The telephone line between Medo and St. Clair has been completed and placed in operation.

RACINE, WIS.—The Citizens' Telephone Company, with 2,000 subscribers, has purchased a site for $4,000 and will erect a telephone exchange.

FRANKFORT, KY.—The London Telephone Company and the Manchester Telephone Company have consolidated with a capital of $15,000.

WAUKEGAN, ILL.—A farmers' telephone company in which H. C. Edwards is interested will build a line from Rollins to Gray's Lake.

SAN LUIS OBISPO, CAL.—The Sunset Telephone Company has arranged for a suburban line which is to extend through the Santa Maria oil field.

PHILADELPHIA, PA.—The Bell Telephone Company of Philadelphia has reduced its pay station rates in the suburbs from ten cents to five cents a call.

LOGANSPORT, IND.—A franchise has been granted by the board of trustees, of Flora, to the Flora & Bringhurst Cooperative Telephone Company, recently organized.

DOVER, DEL.—The Diamond State Telephone Company has installed three additional lines, connecting Brenford, Del., Goldsboro, Md., and Henderson, Md., with Dover.

SCOTTSBORO, ALA.—The Bell Telephone Company, with headquarters in Atlanta, has bought out the system of the Cumberland Telepnone Company at this place and Fort Payne.

AINSWORTH, NEB.—The Keya Paha & Brown County Telephone Company has voted to run a double wire to connecting points,

work to be commenced at once. At the annual meeting, William Stonicker was elected president; F. A. Baldwin, treasurer, and W. H. Williams, secretary.

CENTRALIA, ILL.—C. D. Morey and Hugh Prill, of St. Louis, and G. E. Eis, Al Harding, Robert Rohl and others have secured a franchise to operate a telephone exchange in this city.

ST. LOUIS, MO.—A deed has been filed transferring the franchise of the St. Clair & Eastern Telephone Company to the Kinloch company, the consideration named in the deed being $1.

FORT DODGE, IOWA—The Fort Dodge Telephone Company has completed the improvements to its city system, and is now about to commence the construction of several farmers' lines.

OMAHA, NEB.—Connections have been made between the Plattsmouth Independent Telephone Company's lines and the wires of the Lincoln company, giving Cass County service with the city of Lincoln.

ST. LOUIS, MO.—The Kinloch Telephone Company has bought a $200,000 site, and will at once proceed to erect a twelve or fifteen-story building, at a cost of $850,000. The company will, it is said, retain the four top floors of the new building for its own office exchange.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has commenced work on the extension of its lines from this city to Kaukauna, to give a direct wire north and west. From $7,000 to $10,000 will be expended in improving the system of the company in this city.

NORTH ATTLEBORO, MASS.—The Providence Telephone Company has arranged with the town authorities to place its wires underground. The telephone company agrees to have the work completed within a year, and to allow the town to have four wires in the conduits for its own use.

BANGOR, ME.—The Moosehead Telephone Company has commenced the construction of a trunk line from Greenville to Kineo. This line is to connect with the new copper line which the New England Company is extending from Monson to Greenville, thus affording improved facilities for long-distance telephoning.

CONNERSVILLE, IND.—The Brownsville Cooperative Telephone Company, which was granted a franchise by the city council recently, now has lines in the northwestern part of Union County and in Fayette and Wayne counties, with a central exchange at Brownsville. Under the terms of the franchise it will extend its lines into Liberty.

KALISPELL, MONT.—The telephone line which is now being constructed throughout the valley will be completed during July. Twenty-four miles, covering the ground northwest of Kalispell, have been completed, and the remainder of the work is well under way. When the line is completed to all parts of the valley, the company will have over ninety miles of wire.

SAN DIEGO, CAL.—At a meeting of the directors of the Home Telephone Company it was voted to create a bonded indebtedness of $500,000. For the present only two-thirds of this sum will be floated, and it is stated that that amount has already been underwritten by local and northern capitalists. Work has been commenced, and the system will be in operation by the end of the year.

EXCELSIOR, MINN.—The Minnetonka Telephone Company has made important extensions to its lines. A line has been built to Chanhassen, and one to Saga Hill, Bederwood and Crystal Bay. A new switchboard has been put in at Markville, and the station at Excelsior has been greatly enlarged. The Tristate Telephone Company is extending its lines west from Minneapolis on the north side of Lake Minnetonka, and also through Willmar to Fargo.

PHOENIX, ARIZ.—The Phoenix Independent Telephone Company has been formed to install an independent system. It is proposed to utilize a franchise held in the name of Jerry Millay, a local attorney. The system is to have full metallic circuits and the initial expenditure for installation is to be about $50,000. The promoters have entered into a combination with two independent telephone systems of the territory, that of Frank Wright, with headquarters at Prescott, and the Gila Valley Telephone Company, whose lines extend from Roosevelt, at the Tonto dam site, by way of Globe and the Gila Valley towns, to Clifton and Morenci.

NEW INCORPORATIONS.

ORANGEBURG, S. C.—Star Telephone Company. $700.

CHARLESTON, S. C.—Coast Line Telephone Company. $15,000.

GILLETT, ARK.—People's Union Telephone Company. $25,000.

CHARLESTON, S. C.—Charleston & Sea Island Telephone Company. $15,000.

LINCOLN, NEB.—The Greeley County Telephone Company. $10,000.

INDIANAPOLIS, IND.—Monroe Mutual Telephone Company. $2,250.

MADISON, WIS.—Kuchhayne & Cedarburg Telephone Company. Increased to $1,500.

WESTMINSTER, OHIO—The United Farmers' Telephone Company. Increased from $10,000 to $20,000.

CAMBRIDGE, ME.—Cambridge Telephone Company. $10,000. President, F. J. Hersey; treasurer, D. F. Clark, both of Cambridge, Me.

COLUMBUS, OHIO—The Alwidton Telephone Company. $10,000. Incorporators: Al Biglow, D. C. Low, C. F. Poulson, P. C. Biglow and V. E. Cunningham.

AUGUSTA, ME.—Searsport Electric Light Company. $10,000. Officers: president, Harry L. Cram, of Portland; treasurer, A. J. Desmond, of Portland.

WILSON, N. C.—Wilson Light and Power Company. $125,000. Incorporators: J. C. Hale, B. F. Lane, Claudius Aycock, E. L. Armfield and David Daniel.

JONESBORO, ARK.—Automatic Home Telephone Company. $25,000. Directors: R. L. Collins, F. C. Watts, A. C. Gambill, R. L. Jones and S. A. Daniels.

NASHVILLE, TENN.—Independence Telephone Company. $1,000. Incorporators: W. C. Arrington, J. P. Belcher, H. R. Ryan, D. E. Seay and C. B. Murphy.

AUSTIN, TEX.—Bay City & Matagorda Telephone Company. $5,000. Incorporators: W. W. Boulden, R. H. Traylor, of Bay City; A. W. McNabb, of Matagorda.

JERSEY CITY, N. J.—The Stockbridge Electric Company. $25,000. Incorporators: Stephen Dudley Field, Robert C. Stetson, Edwin Lawson and Philip Fernsmith.

NASHVILLE, TENN.—Standard Electric Company. $15,000. Incorporators: Thomas Deadrick, L. H. Geny, Oscar Geny, W. H. Gewar, W. W. Page and Harry A. Luck.

INDIANAPOLIS, IND.—Boone Township Telephone Company. $1,000. Directors: William Sullivan, Scott W. Thurston, H. H. Markle, T. W. Sullivan and James T. Smith.

LENA, WIS.—The Farmers and Merchants' Telephone Company. $4,000. Incorporators: J. N. Bassett, Joseph P. Brazeau, J. L. Eschner, J. C. Grant, F. E. Rebman and A. W. Larson.

INDIANAPOLIS, IND.—Wabash Water and Light Company. $160,000. Directors: Edmund Gardiner, Whitney Conant, Whiting G. Snow, all of New Jersey, and T. W. McNamee and Thomas McNamee, of Wabash.

SANTA FE, N. M.—Johnson Mesa Telephone Company. $5,000. Incorporators: John Utton, Patrick H. Simmons, Thomas G. English, Samuel J. Murray, of Bell, and Edgar W. Fulghum, Thomas B. Lyon and John Thomas Thatcher, of Raton.

ALBANY, N. Y.—The Otsego Home Telephone Company. $40,000. Directors: Frederic C. Ward and A. A. Ward, of Cooperstown; H. A. Harrison and D. D. Harrison, of New York city; T. Harvey Ferris, William L. Foley and Clarence O. Putnam, of Utica.

ST. PAUL, MINN.—The Dassel-Collinwood Telephone Exchange Company. $25,000. Incorporators: S. N. Gaynor, J. J. Leverenz, Simon Oster, John Engquist, Anton Benson, D. E. Murphy, Fred Rudberg and E. E. McGrew. Shakopee Telephone Company. Increased from $3,000 to $10,000.

PORTLAND, ME.—Illinois Traction Company; to operate railroad, telegraph and telephone lines; $5,000,000; president, William B. McKinley, of Champaign, Ill.; treasurer, Edward Woodman, of Portland. Massachusetts Trackless Trolley Company; $25,000; president, Charles O. Barrows, of Portland; treasurer, William M. Payson, of Boston.

PERSONAL MENTION.

MR. CURTIS CLAYPOOLE, treasurer Wirt Electric Company, Philadelphia, was a New York visitor last week.

MR. GEORGE ALEXANDER McKINLOCH, president of the Central Electric Company, of Chicago, is spending this week in the East. Mr. McKinloch has just returned from an extended European trip.

MR. ANSON W. BURCHARD, who is assistant comptroller of the General Electric Company, has recently been appointed assistant to President Coffin. Mr. Burchard's new position is a recently created office.

MR. A. M. YOUNG, vice-president of the Kings County Electric Light and Power Company, sails on June 28 for London, and will remain thirty days in the world's metropolis looking after his large interests on the other side.

MR. FRANCIS S. THAYER, who has for some time past been connected with the Providence, R. I., Gas and Electric Company, was recently appointed superintendent of the Norwich, Ct., municipal gas and electric plant.

MR. J. F. WALLACE, M. Am. Soc. C. E., and chief engineer of the Panama Canal, had the honorary degree of LL.D. recently conferred on him by the Monmouth College, of which college his father was the first president.

MR. R. A. ROSS, E. E., Montreal, Canada, has been engaged by the city of Kingston, Ontario, to submit a report on the necessary improvements to the electric light plant recently acquired from the Kingston Light, Heat and Power Company.

MR. J. F. STRONG, who was manager of the local telephone exchange at Norwalk, Ct., resigned that capacity to take a vacation, and will be succeeded by Mr. Maurice H. Nutting, who has been connected with the company for some time past at New Haven, Ct.

MR. GEORGE F. McCULLOCH, who was president and general manager of the Indiana Union Traction Company, Indianapolis, Ind., has resigned his position to devote his time to his newspaper enterprise, having recently purchased and consolidated the "Indianapolis Journal" and the "Indianapolis Star."

MR. HERBERT E. CANN, chief electrician of the North German Submarine Cable Works, Nordenham, Germany, is in New York making the final tests of the new German cable recently landed on the coast at Coney Island. Mr. Cann will remain another fortnight in this country.

MR. HARRY HORNSBY, chief electrical inspector of the city of Chicago, is about to resign his position, to become sales representative of the Sprague Electric Company, of New York city. Mr. Hornsby's position as inspector will be filled by the civil service commission, which will conduct an examination on July 26.

MR. ROBERT McF. DOBLE, of San Franscisco, Cal., who is a consulting and supervising engineer, making a specialty of hydro-electric power developments and long-distance power transmission, announces that he has become identified with the Abner Doble Company, engineer and manufacturer of tangential water-wheels with needle regulating nozzle.

MR. GEORGE A. DAMON, managing engineer of the Arnold Electric Power Station Company, Chicago, Ill., was married recently to Miss Henrietta B. Diller, daughter of Mr. and Mrs. H. B. Diller, of Chicago. Mr. Damon is well known in electrical and technical circles and it was he, who attracted so much attention a short while ago with an article on "The Opportunities in the Electrical Business."

MR. PAUL H. EVANS has been made purchasing agent and chief engineer of the Federal District Railway Company, which operates an extensive electric traction system in and around Mexico City, Mexico. Mr. Evans will have charge of all the engineering of the company—electrical, mechanical and civil—which includes all construction and maintenance work in addition to purchasing all material and supplies.

MR. FRANK B. KNIGHT, special agent of the American Bell Telephone and Southwestern Telegraph and Telephone companies, is the subject of considerable personal mention in the *Southern Industrial and Lumber Review* for May. Mr. Knight is probably one of the best-known and most popular telephone and telegraph men in the Southwest. He is a prominent figure at all conventions of electrical interests, and took an active part in the recent joint convention of the Southwestern Gas, Electric and Street Railway Association and the Southwestern Electrical Association of Oklahoma Territory, which was held at Dallas, Tex., April 25, 26 and 27.

OBITUARY NOTICE.

MR. JOHN V. CLARKE died at Roosevelt Hospital, New York city, Thursday, June 9, 1904. He was born at Great Bend, N. Y., November 2, 1860. Mr. Clarke in his early days studied law at Watertown, N. Y., and later entered the profession of civil engineering, in which he achieved a national reputation as a builder of water, electric and other large plants while a member of the firm of Moffatt, Hodkins & Clarke. Mr. Clarke built the local water works at Watertown, and assumed controlling interest in it and ran it for eight years. He had a wide acquaintance with men of affairs, and was at one time president of the Hudson & Kinderhook Railway. Later he bought the Le Valley Vitae Carbon Brush Company. Mr. Clarke is survived by a widow, a son and a daughter.

ELECTRICAL SECURITIES.

Recent prophesying of an upward movement was not borne out by the events of the past week. Notwithstanding this, the opinion is very strong in many circles that the general trend of security prices is upward. Last week's price movements were very irregular, and while the market made good progress early in the week, it became unsettled upon the announcement of several large stock issues. From every quarter come continuing reports of favorable weather for a good agricultural output. A matter which is exciting considerable interest is the large demand for copper within the last few months. The exports of this manufacturing product have very greatly increased, and will possibly reach a record value.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 18.

New York:	*Closing.*
Brooklyn Rapid Transit	48⅜
Consolidated Gas	193
General Electric	150
Kings County Electric	188
Manhattan Elevated	146½
Metropolitan Street Railway	111⅝
New York & New Jersey Telephone	143½
Westinghouse Manufacturing Company	175

The regular quarterly dividend of 1¾ per cent on the stock of the Metropolitan Street Railway Company is payable July 15. Books will remain closed from June 24 to July 16.

It is stated that for the first five months of the General Electric Company's fiscal year, the gross business and net profits have been practically equal to last year, the changes in net profits not varying $10,000 per month.

Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	235
Massachusetts Electric	70
New England Telephone	121
Western Telephone and Telegraph preferred	80

The directors of the American Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, and an extra dividend of ¾ per cent, payable July 15 to stockholders of record June 30. Books close July 1 and reopen July 15. The company's instrument statement for the month ended May 31 shows gross output of 103,897, and returned of 51,721, leaving a net output of 52,176, as compared with 60,572 for 1903, and 60,538 for 1902. Since December 31, 1902, the gross output has been 508,372, and the returned 203,046, leaving net of 305,326, as against 253,150 for the corresponding period of 1903. The total number of instruments now outstanding is 4,084,843.

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	55
Electric Storage Battery preferred	55
Philadelphia Electric	6
Union Traction	50
United Gas Improvement	82¼

The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent from the net earnings of the company on both common and preferred stocks, payable July 1 to stockholders of record at the close of business on June 25.

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	142
Metropolitan Elevated preferred	57
National Carbon common	26½
National Carbon preferred	100
Union Traction common	5
Union Traction preferred	29

The old directors were reelected at the meeting of the Chicago Edison Company.

ELECTRIC LIGHTING.

CLEMENTON, N. J.—The Clementon Township Electric Company has completed its extension to White Horse.

ST. PAUL, MINN.—Work has been commenced on the new electric light plant to be installed at South Stillwater.

ASBURY PARK, N. J.—The Atlantic Coast Electric Light Company has been awarded a three-year contract for municipal lighting, at $80 per lamp per year.

GREENE, IOWA—The Greene Electric Light and Power Company has been organized for the purpose of purchasing of L. F. Pfiffner his electric light plant.

QUINCY, ILL.—The Quincy Gas and Electric Company has perfected plans which will require an expenditure of $50,000 for improvements during the coming summer.

MENASHA, WIS.—The Wisconsin Traction, Heat, Light and Power Company has extended its lines into this city, and is now furnishing current for light and power purposes.

SAG HARBOR, N. Y.—The proposition to construct an electric light system and to issue bonds in the sum of $24,000 to pay for the same was defeated at a recent special corporation meeting.

READING, PA.—The Reading company has enlarged its electrical plant at Schuylkill Haven by the addition of some thirty-five lights. The company's shop is now also lighted electrically.

MOLINE, ILL.—The Mississippi Valley Traction Company has let the contract for putting in a private lighting plant at Campbell's Island. The plant will have a capacity of 300 to 400 lights.

RUTLAND, VT.—At the annual meeting of the Neshobe Electric Light Company the following officers were elected: President, O. C. Baker; vice-president, Charles Dewey; treasurer, George H. McLeod.

EDINA, MO.—F. A. Wilson has sold a controlling interest in the Edina Electric Light and Power Company to Peter R. Peterson, of Rock Spring, Wyo., who contemplates making improvements to the plant.

IOWA CITY, IOWA—The Iowa City Electric Light Company has secured from the city a five-year contract for street lighting, to date from June 1, 1904. The price paid will be $71 per lamp per year.

SUNDERLAND, MASS.—It is expected that the new electric light plant will be in operation in about a month's time. The power-house will contain a Thomson-Houston generator adequate for 600 lights.

OGDEN, UTAH—A power plant is to be built in Weber canyon for the generation of 2,000 horse-power. The work is being done by the Utah Construction Company, acting for A. F. Parker, of Ogden, and E. W. Wade.

McKEESPORT, PA.—The People's Ice, Light and Storage Company, recently organized, has let the contract for equipping its plant, and by September 1 will be ready to furnish light, heat and power for all purposes.

DAVENPORT, IOWA—The Davenport Gas and Electric Company is installing two new dynamos at its LeClaire street plant, the new machines to be used to furnish power for the new Davenport & Suburban street car line.

FORT THOMAS, KY.—The War Department has allowed $28,000 for the installing of an electric light plant in the post. The contract has been let to the Union Heat, Light and Power Company, and the work is to be completed by December 1.

BINGHAMTON, N. Y.—The park commissioners have awarded a contract to the Binghamton Light, Heat and Power Company for park lighting during the season, at the rate of $5 for incandescent lamps, and 23 cents a night for arc lamps.

PLATTSMOUTH, NEB.—The Plattsmouth gas and electric light plant was sold recently at auction to the New Hampshire Bank Company for $13,334, to satisfy a mortgage of $32,799. It is stated that private parties are talking of putting in a new plant.

PITTSTON, PA.—The contract for the construction of the Ashley Electric Light Company's line to Wilkesbarre, where a franchise was secured a short time ago, has been awarded to J. G. White & Company, of New York, and work will soon be started.

SEYMOUR, CT.—The Seymour Electric Light Company has been sold to W. H. H. Wooster and George E. Matthies. The old officers have resigned, and reorganization has been effected by the election of Mr. Wooster as president and Mr. Matthies secretary and treasurer.

OSWEGO, N. Y.—A deal has been closed whereby the People's Gas and Electric Power Company secures the water rights on the Hydraulic Canal, on the site of the old Washington mills. This has been made necessary by the greatly increased demand for power.

ATHENS, GA.—The city council has entered into a contract with the Athens Electric Railway Company for city lighting. The contract is to expire on January 1, 1910, and to carry the privilege of renewal until January 1, 1915, the city paying at the rate of $52 per lamp per year.

PENN YAN, N. Y.—The village board of trustees has about decided to let the contract for the construction of the new municipal lighting plant, which the village is to operate in connection with its water plant, and it is expected that the system will be in working order by the last of September.

MUNCIE, IND.—The city council has granted the Muncie Electric Light Company a new franchise, whereby the company's electric lighting and heating franchises are made to expire in the same year. By the new franchise the company must pay into the city treasury two per cent of its gross earnings.

BANGOR, ME.—At Great Works, in the city of Oldtown, the Penobscot Chemical Fibre Company is constructing a stone dam, and will put in the foundations of a large electric power station, to be operated by the water power of the river. The power generated will be transmitted to various points up and down the river.

JACKSONVILLE, FLA.—At a meeting of the board of bond trustees, the action of the committee on electric light plant, in awarding a contract for furnishing a 500-kilowatt turbo-generator for the municipal plant to the General Electric Company, was approved. The machinery called for in the specifications will cost $20,200.

GREAT BARRINGTON, MASS.—Henry Roraback, of Canaan, Ct., is securing options on water powers, developed and undeveloped, located on the Konkapot river. It is said that Mr. Roraback represents New Haven, Ct., parties who intend building a big electric light and power plant that shall furnish light, heat and power to Connecticut towns.

DULUTH, MINN.—The Chisholm Light and Power Company, with a capital of $25,000, has been incorporated by Nils Anderson, of Virginia; Henry A. Liedel and Daniel D. Crowley, of this city. Duluth is designated as the principal place of business of the company. The company will operate the electric light plant now building at Chisholm, valued at $20,000.

GATE CITY, VA.—R. A. Ayers has organized a stock company to develop the Holston Springs property in this county. On this property the Holston river makes a loop of about a mile, and the company will drive a tunnel through the ridge and turn the entire current through a large turbine wheel, driving an electric plant and furnishing power for other purposes.

MERIDEN, CT.—At the annual meeting of the stockholders of the Meriden Electric Light Company, the following directors were reelected for the year: Charles A. Learned, F. C. Sherman, Samuel Dodd, Walter Hubbard, E. J. Doolittle and George M. Curtis. At a meeting of the directors immediately following, these officers were elected: president, Walter Hubbard; secretary and treasurer, Samuel Dodd; general superintendent, Charles A. Learned.

JAMESTOWN, N. Y.—The report of the superintendent of the municipal lighting plant shows that the cost of arc lamps to the city was $35.28 per year each, but by deducting the expense of lighting for the city hall and fire houses, estimated at 4 cents per kilowatt-hour, the net cost of each arc was brought down to $28.34 per year. The operating expenses, including insurance and interest on bonds, aggregated $25,297.26. The number of arcs supplied was 347, twelve of which, with 1,266 incandescents, were in public buildings, an all night, every night schedule being in force.

ELECTRIC RAILWAYS.

LA CROSSE, WIS.—The La Crosse & Southeastern electric road stockholders plan to run a line between here and Viroqua, Wis. The road may be completed this year.

ALBANY, N. Y.—The state board of railroad commissioners has granted the petition of the Orange County Traction Company to issue a mortgage of $100,000 for construction work on its Newburg-Walden line.

DAKOTA CITY, NEB.—The promoters of the proposed electric line between Sioux City and Homer say they will have cars running on the road by the fourth of July. The power for the line is to be furnished by the Sioux City Traction Company.

MUSKOGEE, I. T.—At a meeting of the city council a franchise was granted to Ira L. Reeves and associates for the construction of a street railway in this city. The franchise calls for an electric system and the work is to be commenced at once.

TOLEDO, OHIO—The Toledo & Northwestern, formerly the Ohio & Michigan, has secured a franchise through the town of Dundee, Mich. This completes the right of way from Toledo to Ann Arbor, and the company is now in shape to push construction.

MICHIGAN CITY, IND.—The Chicago & South Shore Railway Company is soon to have a new power-house at Burnside, plans and specifications having been prepared and approved for two brick structures, one seventy feet by thirty feet and the other forty feet by thirty feet.

NEW DECATUR, ALA.—Decatur and Florence parties are contemplating the building of an electric street railroad from this city to Moulton, in Lawrence County, a distance of about twenty miles. The proposed line will run through one of the richest coal, iron, timber and agricultural sections in Alabama.

NEW ORLEANS, LA.—The Bodcan Valley Railway Company has been organized with a capital of $60,000, with H. H. Wheles, as president. A line will be built from Alden bridge, on the cotton belt, in an easterly direction to Ivan, and thence east to some point hereafter to be determined. Telegraph and telephone lines will also be constructed.

NASHVILLE, TENN.—The grading of the Nashville, McMinnville & Woodbury Railway will commence at once, and it is hoped to have the road completed within a year. The line, as surveyed, will be about seventy miles in length, from Nashville to McMinnville, and, it is estimated, will cost $1,500,000. The company is capitalized at $1,000,000.

ST. LOUIS, MO.—The St. Louis, Kirkwood & Manchester Railway Company has paid into the county treasury $1,000, as required by the franchise recently granted by the county court. The company intends to build a line to Manchester and Valley Park within the next year, though the route has not been definitely agreed upon. Two or more routes are being considered.

STROUDSBURG, PA.—It is said that in the near future the Northampton & Monroe Electric Railway Company, shortly to commence operations between Stroudsburg and Bangor, is to be extended to Mount Pocono, Tobyhanna and thence to Scranton, the ultimate object being a continuous line to Philadelphia. It is believed that the line will be constructed and in operation within two years.

ST. JOSEPH, MO.—Preliminary plans for the St. Joseph & Stanberry interurban line are completed, and it is hoped to begin the work of construction in a short time. The line is to be thirty-eight miles long, and will touch such towns as Avenue City, Rochester, Empire Prairie and Island City. The road will run over the company's own right of way through the country and smaller towns.

NEW ORLEANS, LA.—Plans are being perfected for connecting Biloxi, Mississippi City, Gulfport and Pass Christian by trolley cars, the route of the railway to be along the Gulf coast, a distance of twenty miles. Colonel J. T. Jones, of Gulfport, is interested in the new company, and it is believed actual work will begin in a short time. Colonel Jones also is building an electric line in Gulfport, which will be several miles long.

DETROIT, MICH.—E. M. Hopkins, president of the Grand Rapids & Ionia Electric Railway Company, states that his company has awarded the contract for construction to the Farnham company, of Chicago, construction work to be commenced not later than July 1. The company has deeds or contracts for deeds for the entire thirty-three miles of right of way between Grand Rapids and Ionia. The contract provides that the road shall be entirely finished by April 1, 1905, and ready for operation. The power-house is to be located at Saranac, with a substation at Cascade. The trust mortgage will run to the Chicago Trust Company, which has agreed to become trustee for the bonds.

YOUNGSTOWN, OHIO—The annual meeting of the stockholders of the Youngstown & Southern Railroad was held recently, when the former directors were elected. The directors confirmed the letting of the contract for the construction of the electrical work of the whole line from this city, through Columbiana, Lisbon and Salem to East Liverpool, to J. G. White & Company, of New York. Work will be pushed as rapidly as possible.

OPELIKA, ALA.—The Opelika Railway, Light and Power Company has been incorporated with a capital of $300,000 by J. B. Greene, E. L. Andrews, M. T. Trawick, Bartow Smith, Jr., and Rush Taylor. The company purposes to construct an electric line from Opelika to Auburn, and also to furnish electric lights to both Opelika and Auburn. It is hoped eventually to extend the line to Society Hill and thence by Maroyn back to Opelika.

TOPEKA, KAN.—The management of the Lake Erie & Western has decided to equip its system with electric motors wherever it is paralleled by surface electric lines. It is stated that by the end of the summer motors drawing single cars and running at the rate of fifty miles an hour will be installed between La Fayette and Indianapolis. Trains will be run hourly and will make all stops, thereby relieving the steam cars from stopping at many of the stations.

BUTLER, PA.—The Pittsburg, Etna & Butler Street Railway Company has recorded a copy of a resolution authorizing the construction and extension of its lines from Glenshaw north to Bakerstown, and from thence by branches to Saxonburg, McFann, Mars, Hendersonville, Zelienople, Middle Lancaster, Portersville, Prospect and Butler. The Butler and Pittsburg plank road will be used between these two places, and it is reported ties and rails have already been distributed along part of the road in Allegheny County.

DOYLESTOWN, PA.—Application has been made to the West Conshohocken council by the Lower Merion Street Railway, for right of way through that borough. The purpose of the company is to build a high-speed, double-track trolley line from the terminus of the Philadelphia Rapid Transit line, at Overbrook, to Phœnixville, crossing from Overbrook to Gladwyn, thence to West Conshohocken and on to Gulph Mills and King of Prussia, through Valley Forge, and connecting at Phœnixville with the road extending to Royersford.

DALLAS, TEX.—It is stated that Schufeller Marshall and R. S. Kimbrough, capitalists of Mesquite, in association with several Dallas men, who will be joined by eastern investors, have under way a well-defined movement toward the organization of a company for the purpose of constructing an interurban electric railway to extend from Dallas eastward to Grand Saline, touching the towns of Mesquite, Forney, Terrell and Will's Point. The projected line, it is said, will parallel the Texas & Pacific Railway almost the entire distance.

ALBANY, N. Y.—A certificate of consolidation of the Suburban Traction Company, the Van Nest, West Farms & West Chester Traction Company, the Wakefield & West Chester Traction Company, the West Farms & West Chester Traction Company and the Williamsbridge & West Chester Traction Company, forming the Bronx Traction Company, has been filed with the secretary of state. The total capitalization is $585,000, and the directors are Edward A. Maher, president; Thomas W. Olcott, treasurer; Frank S. Gottnon, Oren Root, Jr., Renu Martin and M. G. Storrett, of New York city; Henry A. Robinson, of Yonkers; Charles E. Warren, D. B. Hasbrouck and I. C. Moorehead, of Brooklyn.

NEW HAVEN, CT.—The merger of the Fair Haven & Westville, Winchester Avenue and Consolidated Railway companies was completed at a meeting of the directors and stockholders of all three companies recently, when the sale of the two former to the latter company was authorized. The Winchester Avenue stockholders will realize about $52 a share, and the sale of the Fair Haven & Westville will pay its stockholders approximately $45 a share. The Consolidated Railway Company was formerly known as the Worcester & Connecticut Eastern road, and is controlled by the New York, New Haven & Hartford road. The Meriden Electric Company will soon be taken over by the Consolidated.

INDUSTRIAL ITEMS.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburg, Pa., has issued its usual attractive calendar for June, 1904.

THE C. J. TOERRING COMPANY, Philadelphia, Pa., announces the removal of its office and factory to 2318 Noble street.

THE MAGNOLIA METAL COMPANY, New York city, N. Y., is sending out its catalogue, which treats on "Magnolia" anti-friction metal. Catalogue will be sent on request.

THE WIRT ELECTRIC COMPANY announces its removal to its new factory, at 3108 Germantown avenue, Philadelphia, Pa., where it will be in a position to fill all orders promptly.

THE ATLAS HANGER MANUFACTURING COMPANY, New York city, N. Y., is sending out a booklet in which is shown and described "Atlas" hangers of various styles. Booklet will be sent on request.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, has issued a leaflet entitled "It Is to Smile," which treats on the "Peerless" lamp which it handles. Leaflet will be sent on request.

W. M. SHEEHAN & COMPANY, New York city, N. Y., illustrates, describes and lists in its catalogue No. 25, which it is distributing, together with a discount sheet, alternating and direct-current desk, bracket and ceiling fans which it handles.

THE EMPIRE ELECTRIC SUPPLY COMPANY, Chicago, Ill., is distributing its bulletin No. 12, which treats on the telephones and accessories which the company handles, together with telephone price list No. 48 and construction material price list No. 47.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., is issuing a very fine bulletin, it being its No. 11. This bulletin illustrates, describes and lists in a clear way the generator call telephones and parts which the company manufactures.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing a pamphlet entitled "Oil *versus* Grease Lubrication." This pamphlet takes up the special advantages of Dixon's graphite greases. The book contains valuable information for users of all grades of power apparatus.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., is issuing its bulletin No. 83, showing the application of storage batteries to alternating-current generating stations and the operation of chloride accumulators in connection with the exciter circuits of large alternating-current generating stations.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is distributing its bulletin No. 1026, which supersedes Nos. 1012 and 1013. Bulletin No. 1026 is illustrative and descriptive of multipolar motors and generators, type "H" and "H. I.," as manufactured by the company. Bulletin will be sent on request.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is meeting with considerable success in the installation of "Packard" railway lamps. This lamp is designed to stand up under all sorts of hard service to which it may be subjected in street car work. A number of large traction companies throughout the country are now using the "Packard" lamp.

THE SCHUTTE & KOERTING COMPANY, successor to L. Schutte & Company, Twelfth and Thompson streets, Philadelphia, Pa., will be pleased to send a descriptive circular dealing with the construction and application of the Schutte valve. This valve has been redesigned to eliminate some of the troubles which have been experienced with the improper setting of valve seats.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., manufacturer of the "Norbitt" temporary socket, announces that at the "Elks" convention to be held in Cincinnati, Ohio, July 8 to 25, 1904, there will be used nearly 30,000 "Norbitt" porcelain temporary sockets for decorative purposes, and that over 500 "Norbitt" temporary sockets will also be used in making the huge American flag, which will hang over Government Square.

MR. FRANK B. GILBRETH, M. Am. Soc. M. E., general contractor for architectural and engineering construction, New York, Boston and Baltimore, is sending out a leaflet illustrating a plant which was designed by him, built and started running in eleven months. He has also sent out cards containing a list giving the time of high tides at various places. Leaflet and cards will be sent on request.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, is issuing a circular entitled "The Solution of the Incandescent Lamp Question." The company is also sending out other circulars, illustrative and descriptive of the "Sterling" special incandescent lamp, together with a postal card addressed to the company on which to make out a trial order for "Sterling" lamps. All of the above matter will be sent on request.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued the June number of "The Emerson Monthly," together with the "Emerson Bargain Sheet." The publication contains much interesting matter in connection with the company's manufacture, and the bargain sheet illustrates and lists second-hand desk and bracket fans, ceiling fans, new and second-hand induction motors, exhauster fans and direct-current motors, one-quarter and one-third horse-power. Publication and bargain sheet will be sent on request.

THE ENGINEERING COMPANY OF AMERICA, 74 Broadway, New York city, will engage in general engineering construction and contracting business. This is in addition to the strictly professional work in which the corporation has heretofore been engaged. The company has a large amount of work on hand at the present time, covering electric railroad construction, waterworks, power-houses, refrigerating plants, buildings, etc., the details of which will be furnished on application. It is now prepared to accept bids from sub-contractors on such work as it has at its office.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, manufacturer of the "Cross" oil filter, states that the authorities in charge of the power plant at the St. Louis Exposition have installed a large No. 3 "Cross" oil filter. Those who visit the Fair, and who are interested in the mechanical features of the oil filter, should take this opportunity of seeing it in practical operation. It may be of further interest to note that the following companies have ordered a "Cross" oil filter to be used in connection with their exhibit at the Fair: C. H. Bradley, Jr., Company, Pittsburg, Pa., Buckeye Engine Company, Salem, Ohio, and the De Laval Steam Turbine Company, Trenton, N. J.

THE UNIVERSAL ELECTRIC COMPANY, Chicago, Ill., which is a new concern, has opened general sales offices in the Ellsworth Building, 353-357 Dearborn street, Chicago, Ill. Its officers are: F. C. Royal, president, and F. B. Kavanagh, secretary and treasurer. Mr. Royal is a well-known Chicago business man, having been connected with the Nelson Morris packing-houses for a number of years, while Mr. Kavanagh was formerly with the Sterling Electrical Manufacturing Company, Warren, Ohio, and later of the Brilliant Electric Company, Cleveland, Ohio. This new company is the northwestern agent for the Brilliant Electric Company, maker of the "Universal" tipless incandescent lamp. In addition to this product it will carry a full line of arc lamps, fans, motors, generators, telephone apparatus, etc., as well as several special lamp accessories.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has been making a number of important sales during the past week. Among these may be included about $30,000 worth to the Barbour Flax Spinning Company, Paterson, N. J. The equipment includes a 600-kilowatt standard direct-current 250-volt generator, and motors with ratings from 5 to 100 horse-power, aggregating 515 horse-power. The W. & J. Knox Net and Twine Company, for a plant in Baltimore, Md., has bought a 100-kilowatt generator and seventy-five horse-power in motors. The United States Naval Academy, Annapolis, has purchased two 250-kilowatt Crocker-Wheeler generators for a two-unit three-wire lighting system. The J. B. Williams Company, Glastonbury, Ct., has purchased a 150-kilowatt engine-type generator. Armour & Company, Chicago, Ill., who already have in use Crocker-Wheeler motors to the amount of about 7,000 horse-power, have placed an order for three more machines aggregating 110 horse-power. Twenty-eight motors of the same make, with a combined power of 253 horse-power, have been purchased by the Traitel Marble Company, Ravenswood, L. I.

EXPORT AND DOMESTIC NUMBER

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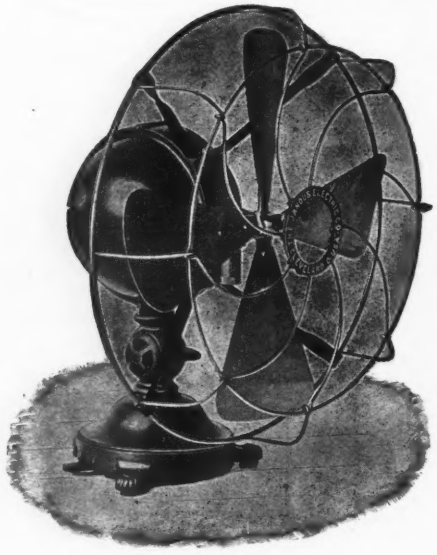

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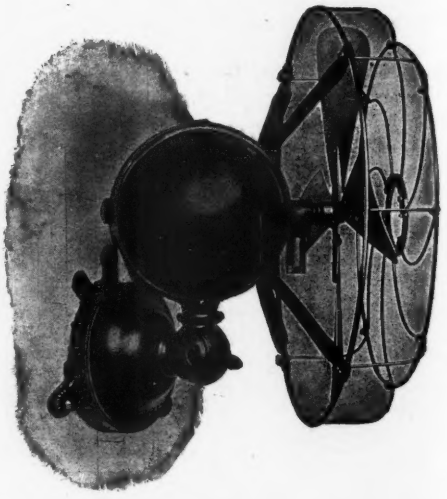

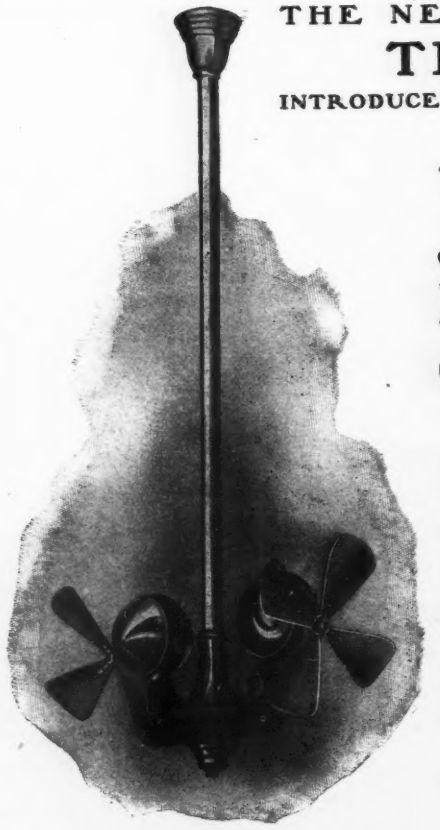

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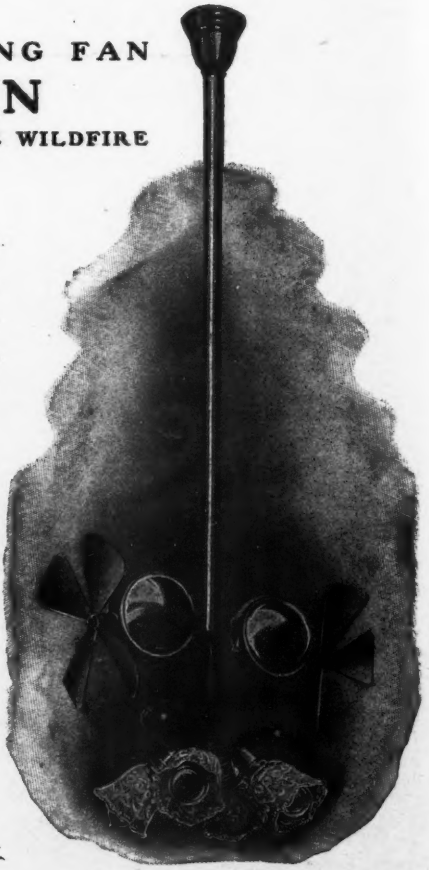

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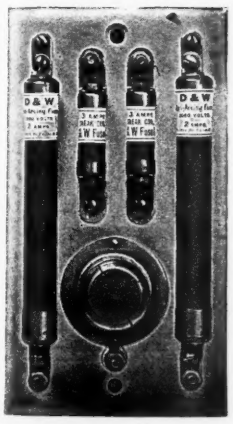

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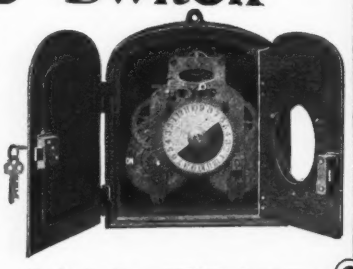

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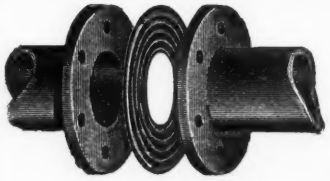

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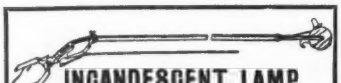

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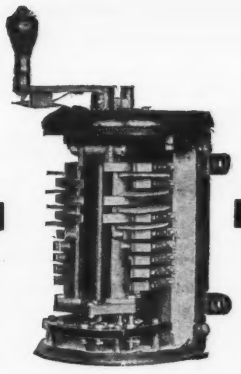

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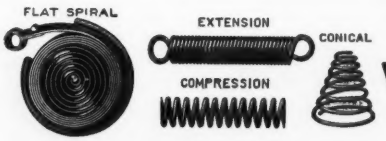

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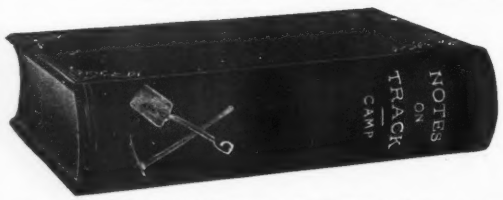

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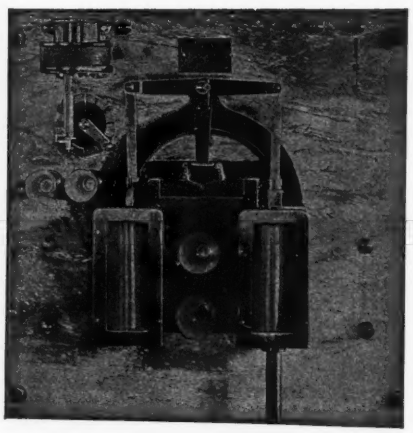

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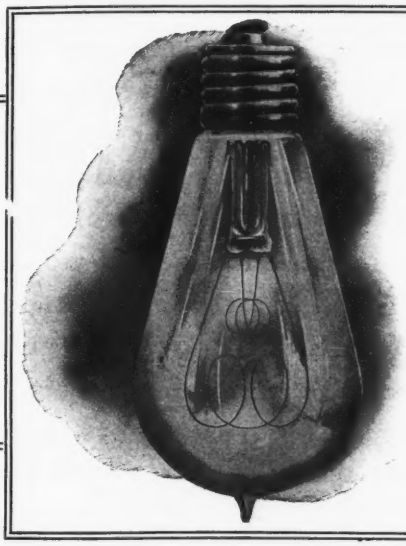

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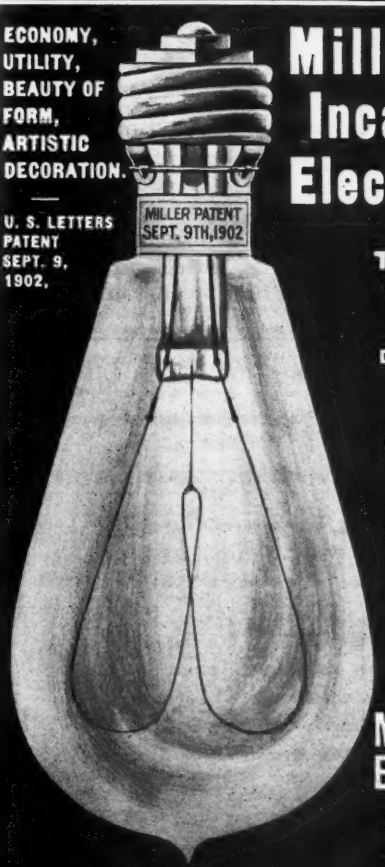

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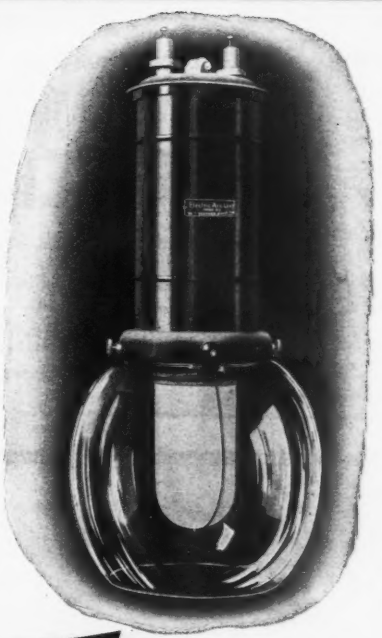

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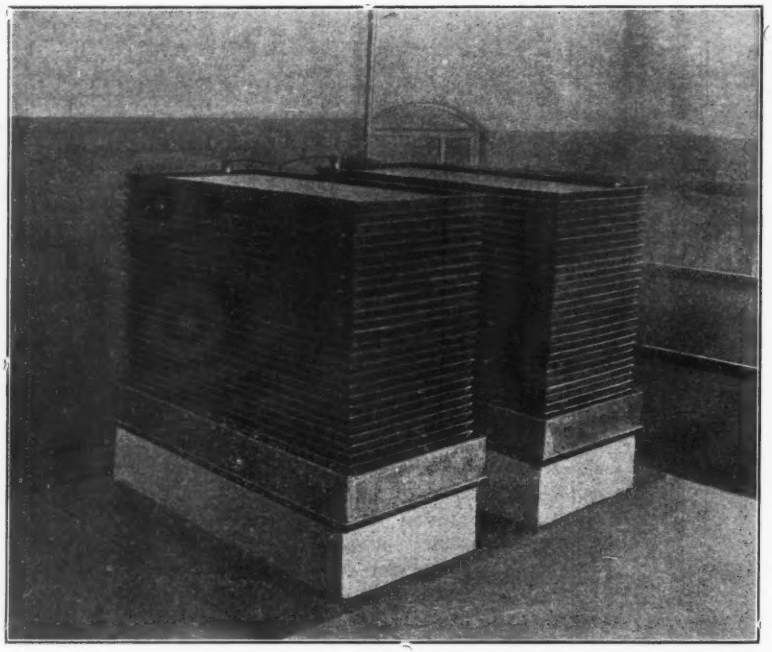

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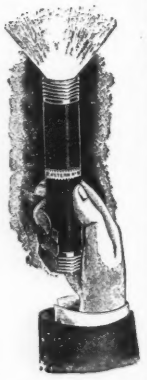

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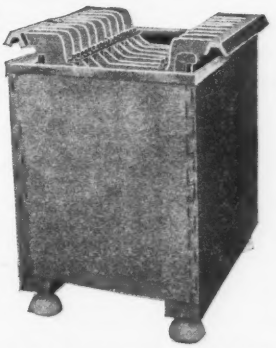

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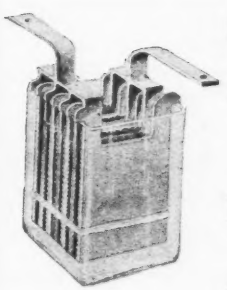

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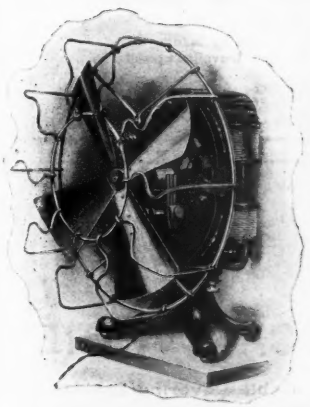

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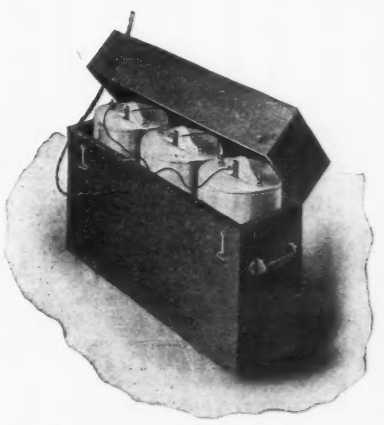

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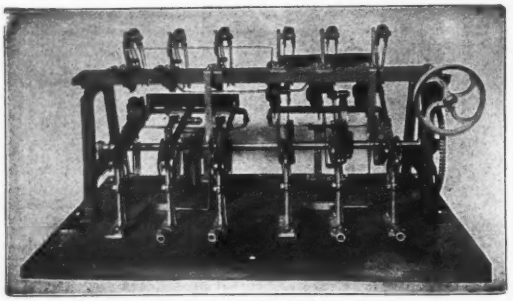

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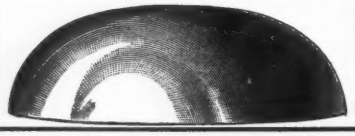

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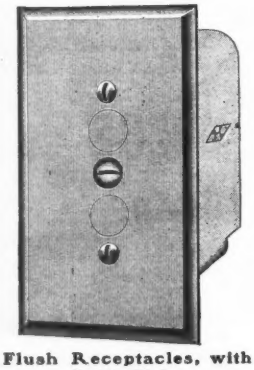

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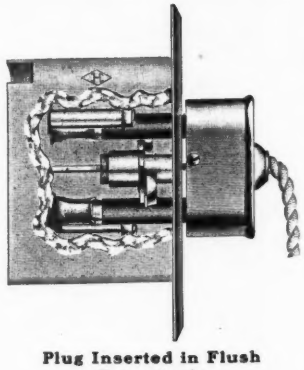
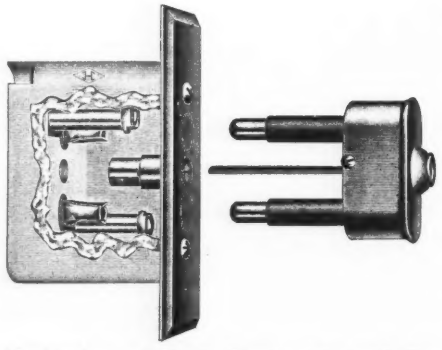


Plug Inserted in Flush Receptacle



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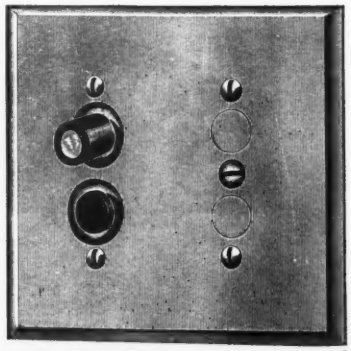

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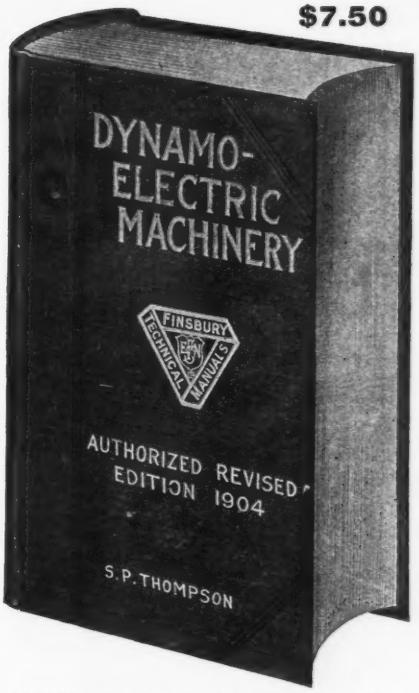

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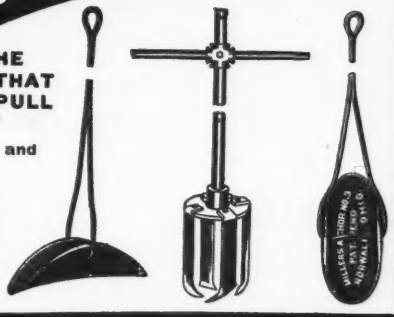

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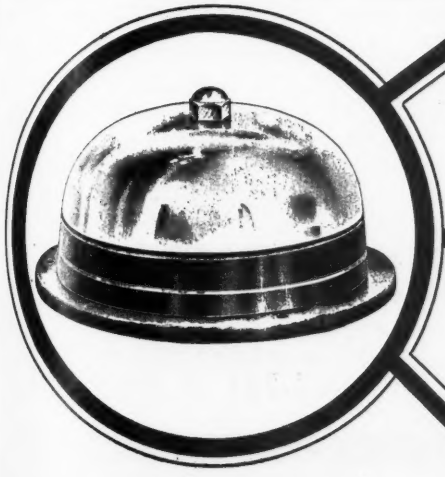

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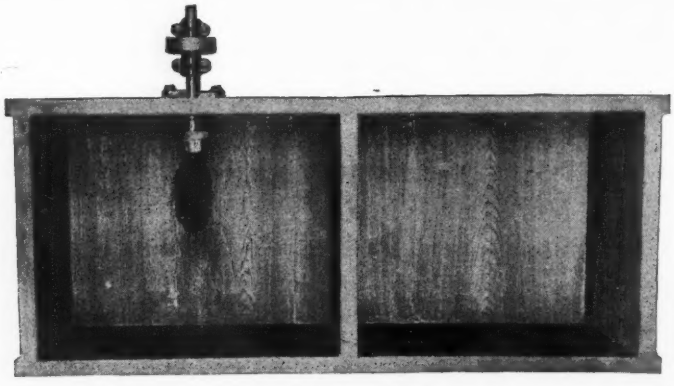

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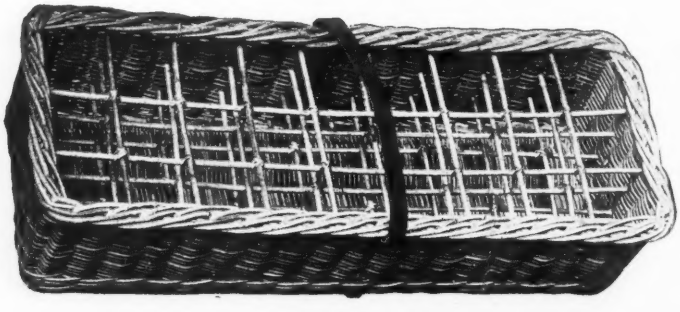

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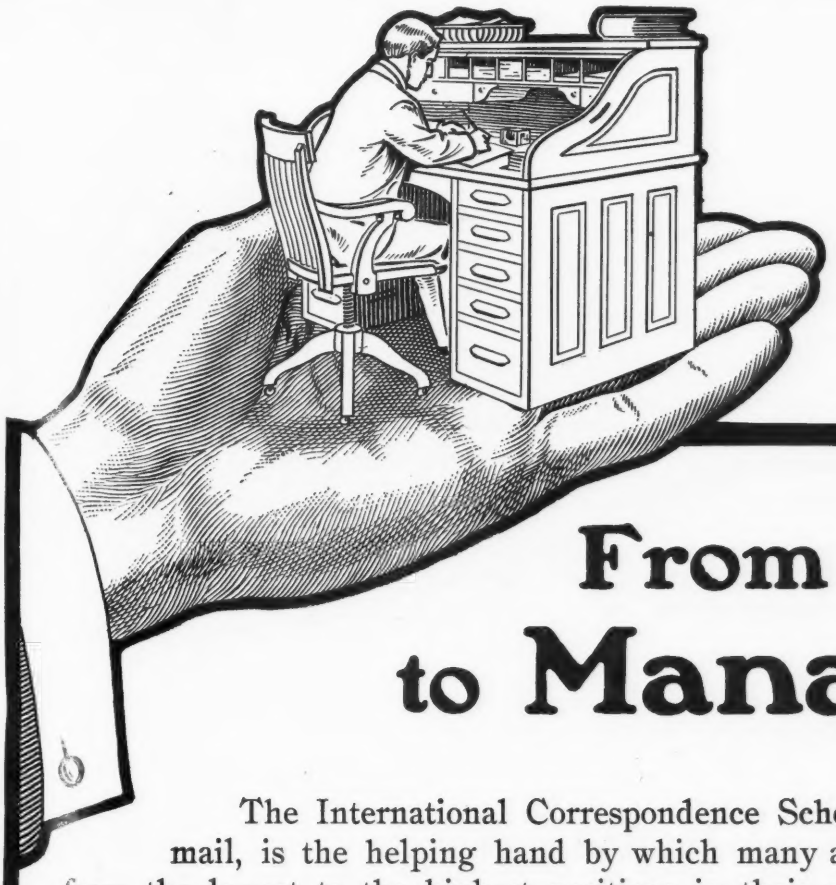

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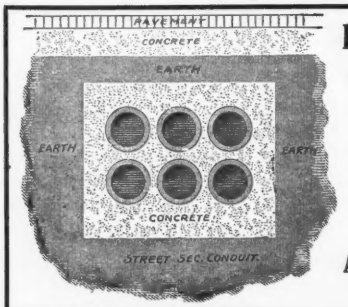

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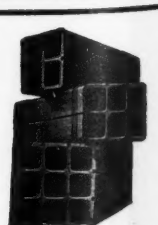

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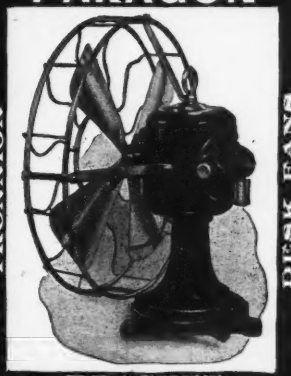

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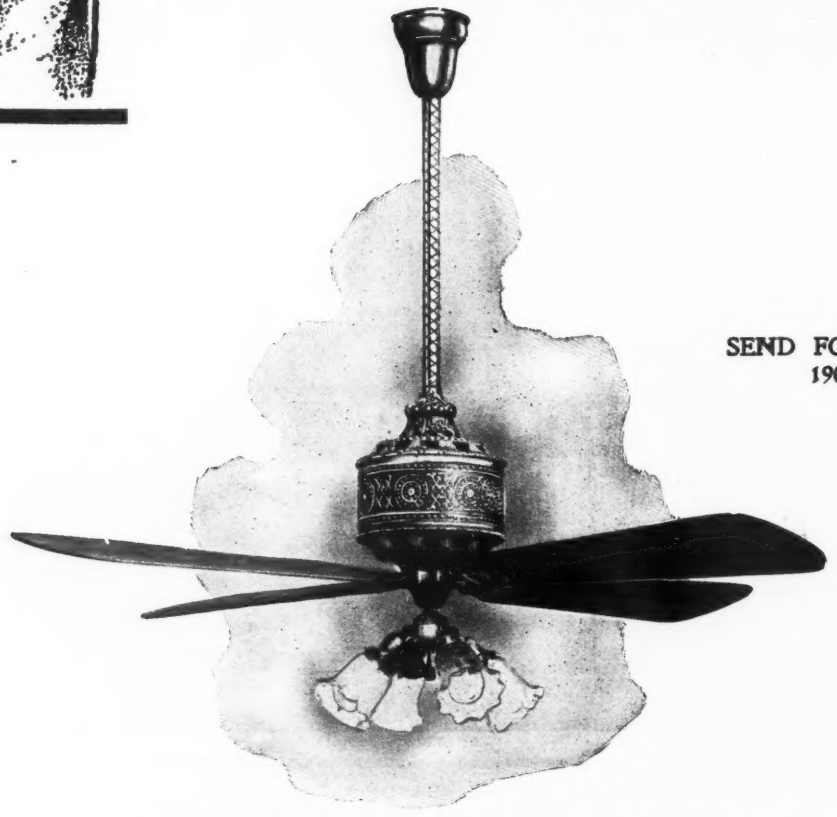

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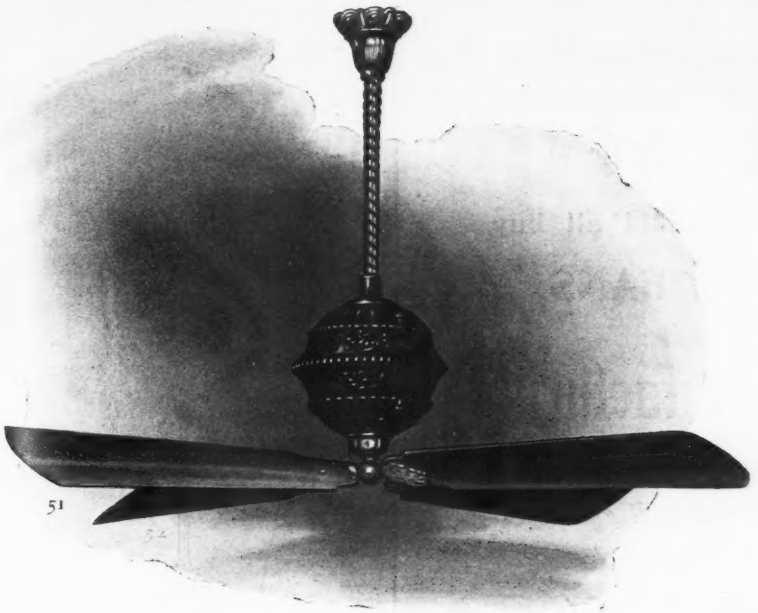

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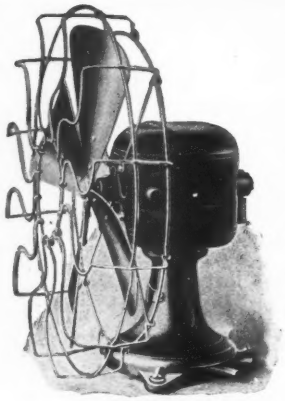

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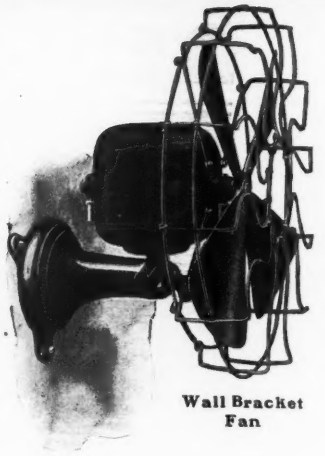

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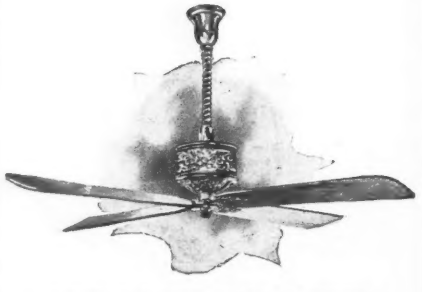

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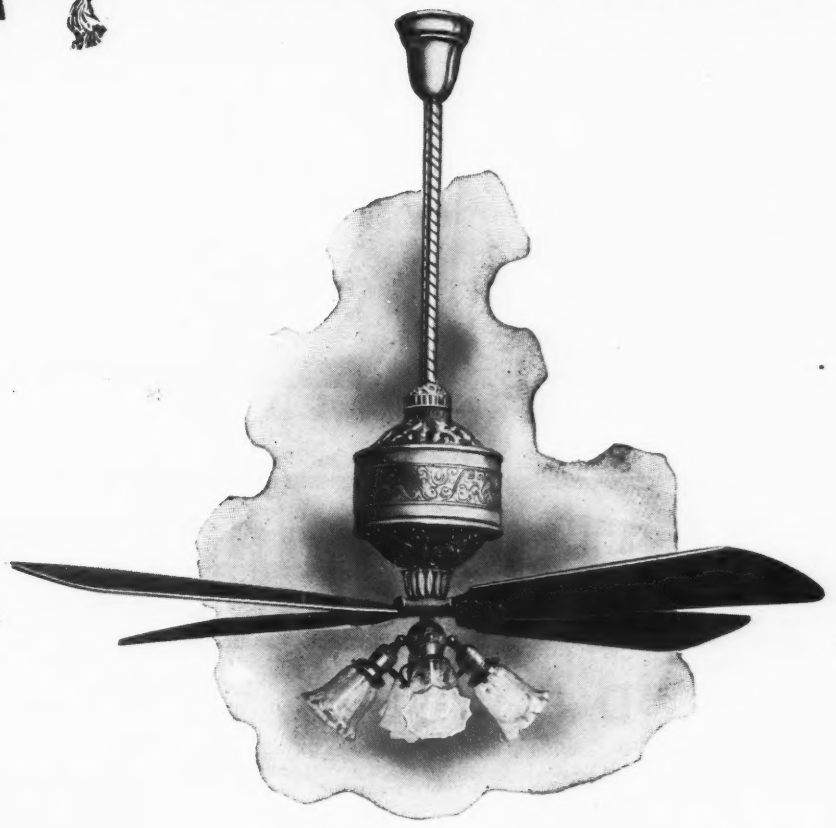

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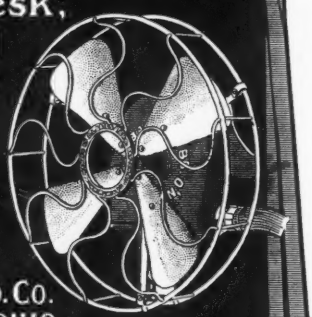

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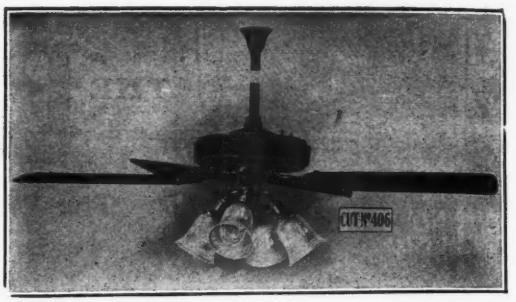

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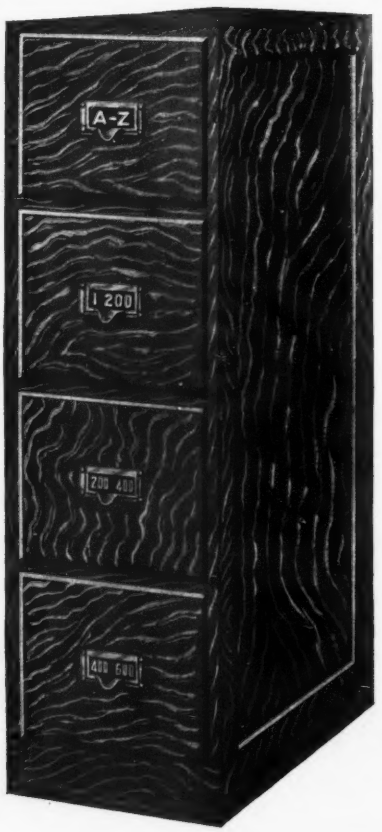

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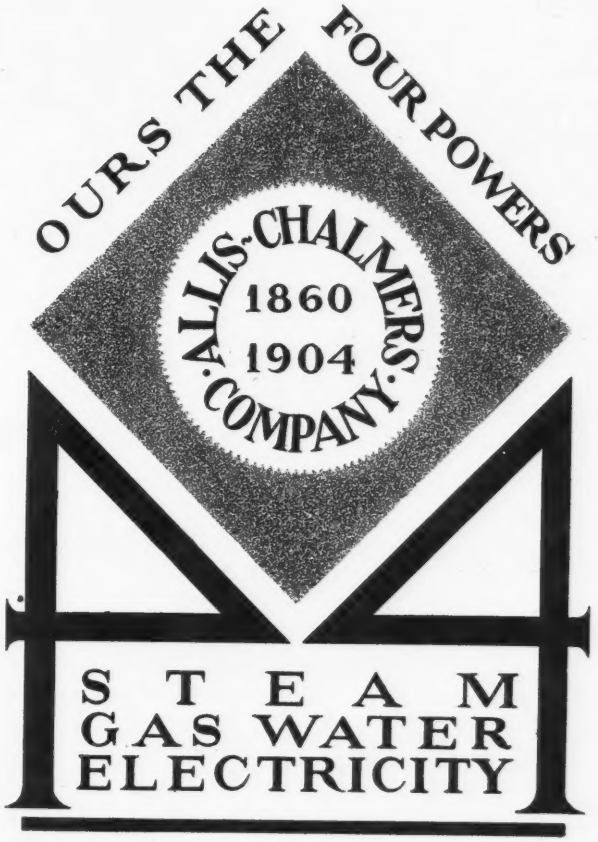

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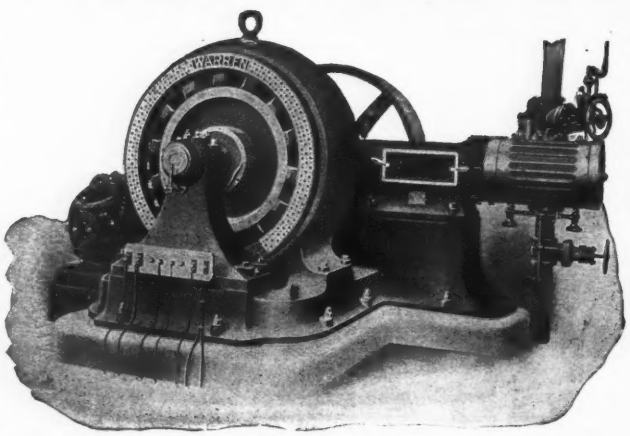

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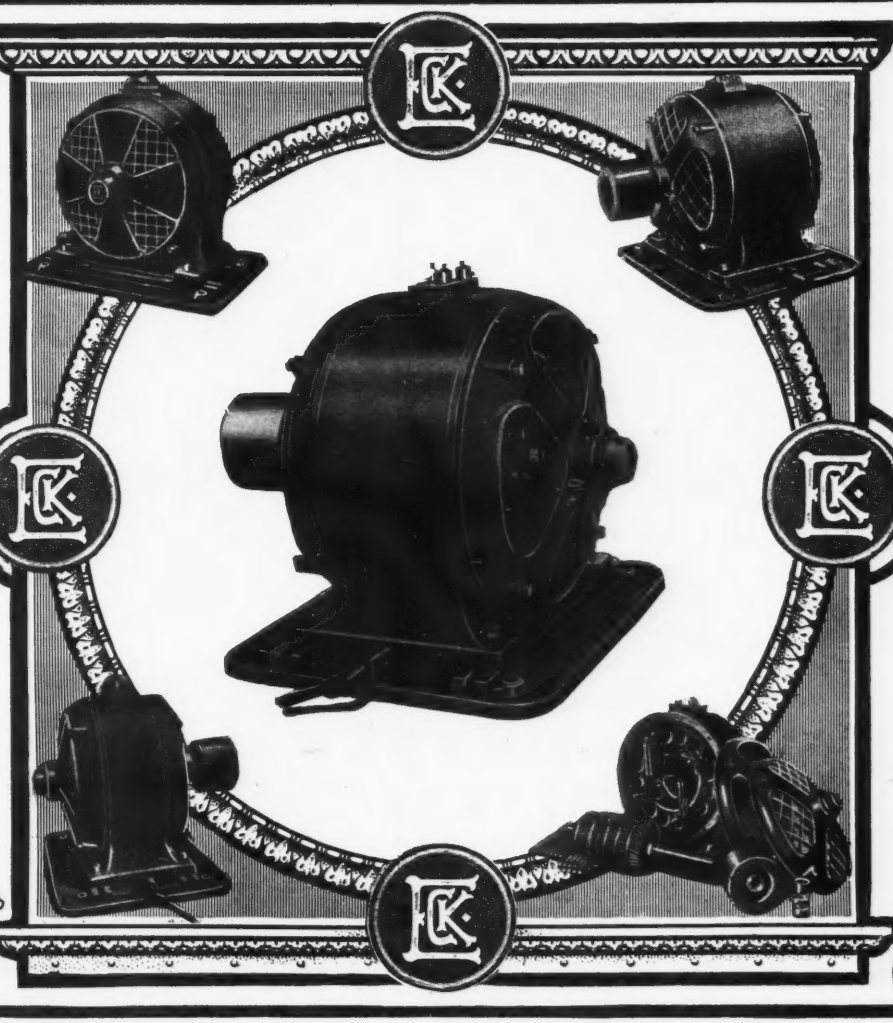

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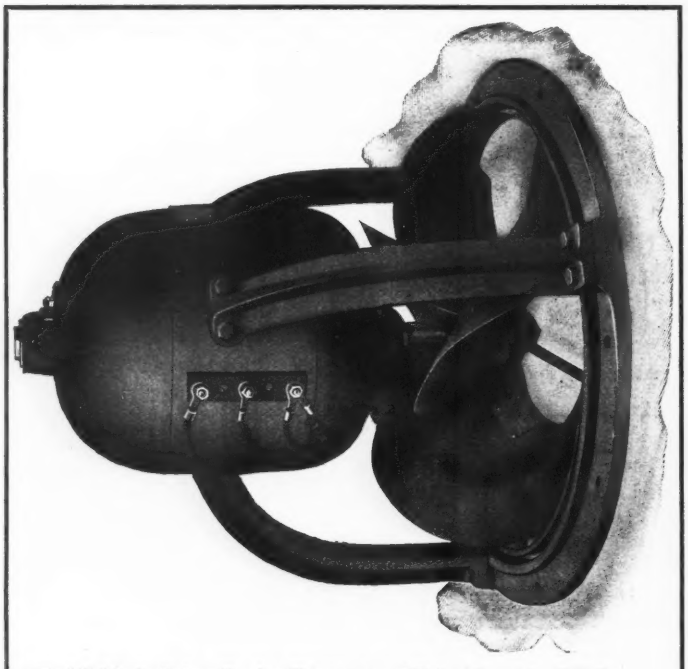

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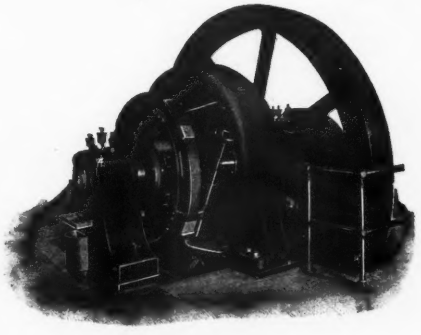

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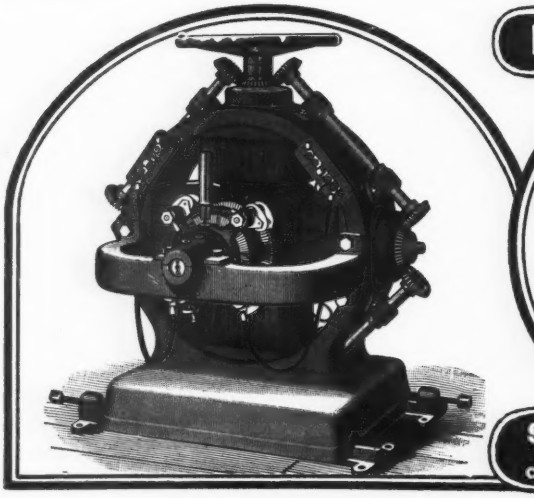

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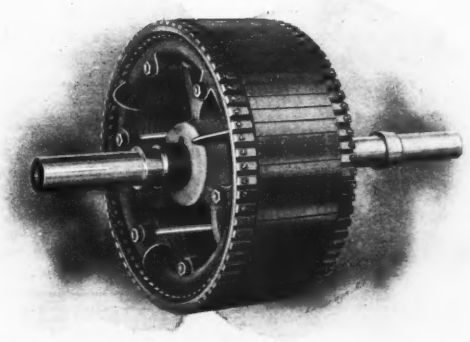


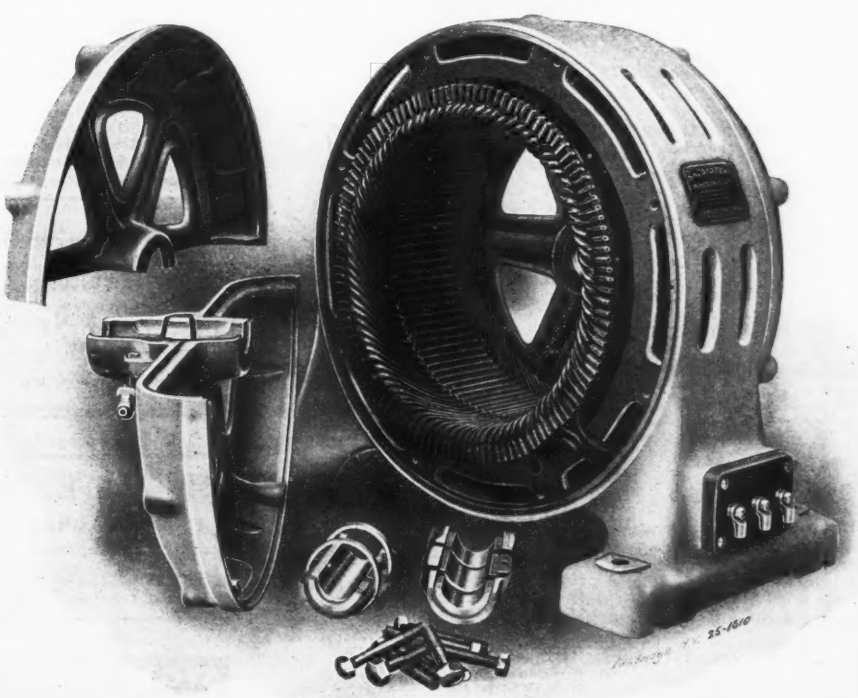
ARMATURE OF TYPE A MOTOR

"TYPE A" MOTOR

As can be seen from the accompanying illustrations, this is the simplest type of motor extant. The armature is one of the "squirrel cage" pattern and wear on the motor is reduced to that which takes place in the bearings. With this type of motor a starting compensator is generally used. This simple device reduces the potential applied to the primary of the motor resulting in a corresponding decrease in the starting current.

"TYPE B" MOTOR

In this type, the starting current is kept low in introducing starting resistance within the secondary circuit. This motor does not possess the same simplicity of construction as the type A, owing to the fact that the armature has a polar winding and a device for varying the armature resistance is a necessary adjunct in its construction, but it has this advantage—it will start a given load with a current materially less than that taken by the type A. Therefore, it is recommended where the motor must start heavily loaded and where a large current, such as the motor with short-circuited armature takes when starting at full load, would be objectionable.



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(Variable Speed Motor)

The armature of the type C motor has a polar winding from which leads are brought through the hollow shaft to collector rings by means of which connection is made with a suitable controller for varying the resistance in the secondary circuit. In this way the desired speed regulation is secured. As is obvious, the controller constitutes a most satisfactory starting device.

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218

INDEX TO ADVERTISERS.

A

Adams-Bagnall Electric Co..... 7
Akron Electrical Mfg. Co..... 30
Allen & Co., L. B.....46,75
Allis-Chalmers Co.....23,79
American Battery Co..... 46
American Bell Telephone Co..... 85
American Business Systems Co... 72
American Carbon & Battery Co... 76
American Circular Loom Co 1
American Conduit Co..... 16
American Diesel Engine Co 79
American Electric Fuse Co..... 28
American Electrical Heater Co.... 12
American Electrical Mfg. Co..... 40
American Electric Telephone Co.. 88
American Electrical Works..... 1
American Engine Co..... 77
American Insulating Machinery Co.. 28
American Platinum Works..... 29
American School of Correspondence .....
American Stone Conduit Co..... 16
American Vitrified Conduit Co.... 17
American Vulcanized Fibre Co.... 6
American Watchman's Time Detector Co.. 77
Arnold Electric Power Station Co.31,82
Ashcroft Mfg. Co.....
Asheville Mica Co..... 29
Atlantic Insulated Wire & Cable Co. 78
Atwater Kent Mfg. Works..... 86
Automatic Electric Co..... 83

B

Babcock & Wilcox Co..... 79
Baker & Co.. 46
Baker & Co., W. E..... 82
Baker, Jos. B..... 82
Ball & Wood Co..... 79
Ballou-Hutchins Co..... 28
Barnes Co., The Wallace..... 6
Barr, W. J..... 86
Barron & Co., Jas. S..... 75
Barstow, W. S..... 82
Bates & Bro. Co., D. L..... 22
Bates Machine Co 78
Benjamin Electric Mfg. Co. 29
Benson & Co., William W..... 16
Biddle, Jas. G..... 46
Big Four R.R..... 78
Bishop Gutta-Percha Co..... 1
Bossert Electric Construction Co... 16
Boston Electric Co..... 78
Brady, T. H..... 28
Bridgeport Brass Co.....
Brilliant Electric Co..... 86
Bristol Co..... 1
Brown & Co., Clifford H..... 28
Bryan, Wm. H..... 82
Bryan-Marsh Co..... 39
Buckeye Electric Company.....
Bullock Electric Mfg. Co..... 23
Bunnell & Co., J. H.. 4
Bureau of Expert Investigation & Construction..... 82
Burnley Battery & Mfg. Co..... 77
Burt Mfg. Co..... 3
Byllesby & Co., H. M..... 82

C

Calculagraph Company..... 87
Camp Co., H. B..... 16
Camp, W. M..... 6
Cary Spring Works..... 6
Case Bros..... 75
Central Electric Co..... 12
Century Electric Co..... 41
Chase-Shawmut Co. 30
Chicago & Alton Railway..... 13
Chicago Edison Co..... 30
Chicago Fuse Wire & Mfg. Co.... 76
Chicago Insulated Wire Co..... 41
Church, L. H..... 16
Clark, Thos. E., Wireless Tel. & Tel. Co 83
Coho & Co., H. B..... 82
Colonial Fan & Motor Co..... 18
Collyer Insulated Wire Co..... 92
Columbia Incandescent Lamp Co..
Columbus Storage Battery Co 9
Consolidated Engine Stop Co.....

C

Consolidated Railway Electric Lighting & Equipment Co..... 10
Consolidated Safety Valve Co 75
Consumers' Carbon Co..... 4
Continuous Rail-Joint Co. of America. 4
Cope, T. J..... 16
Corson, Wm. R. C..... 82
Crescent Co..... 12
Crescent Insulated Wire and Cable Co..... 92
Crocker-Wheeler Co..... 26
Couch & Co., S. H..... 85
Cutler-Hammer Mfg. Co..... 5
Cutter Co..... 1

D

Dale Co..... 43
Dayton Electrical Mfg. Co..... 24
Dayton Globe Iron Works Co..... 36
Detroit & Buffalo Steamboat Co..
Diamond Meter Co..... 30
Dielectric Mfg. Co..... 9
Diehl Mfg. Co..... 20
Dixon, Jos., Crucible Co..... 6
Doubleday-Hill Electric Co.....
Downward Light Co.....
Driver Harris Wire Co 36
Duncan Electric Mfg. Co..... 8
Dustin Co., Chas. E..... 77
Duvall, E. S., Jr..... 76
D. & W. Fuse Co..... 3

E

Eastern Carbon Works..... 8
Eck Dynamo & Motor Works..... 25
Eccleston Lumber Co..... 83
Economy Electric Co.....
Edison Decorative & Miniature Lamp Department..... ... 46
Edison Mfg. Co. 9
Edwards & Co..... ... 13
Electric Appliance Co..... ... 1
Electric Contract Co..... 5
Electric Gas Lighting Co..... 89
Electric Motor & Equipment Co... 28
Electric Storage Battery Co..... 29
Electric Utilities Co 92
Electrical Engineer Institute of Correspondence Instruction..... 78
Electrical Testing Laboratories.... 8
Elwell-Parker Electric Co..... 30
Eureka Electric Co 88
Ewing-Merkle Electric Co..... 87

F

Feilden Publishing Co., Ltd..... 6
Ferodowill Mfg. Co..... 13
For Sale..... .....
Fort Wayne Electric Works..... 28
Fostoria Incandescent Lamp Co...
Four-Track News, The..... 81
Frankel Display Fixture Co..... 16
Franklin Electric Mfg. Co.....
Franklin Mfg. Co.....
Frink, I. P..... 92

G

Garton-Daniels Co..... 17
General Electric Co..... 35
General Incandescent Arc Light Co. 17
Gest, G. M..... 16
Gould Storage Battery Co..... 3
Green Fuel Economizer Co..... 32
Gunn, Richards & Co..... 82

H

H. O. S. Engineering Co.....
Hanchett, Geo. T..... 82
Hancock Inspirator Co..... 41
Hartford Time Switch Co..... 4
Hart & Co.....
Hart & Hegeman..... 41
Hart Mfg. Co 12
Hartman Circuit-Breaker Co..... 9
Hayden & Derby Mfg. Co.....
Hazard Mfg. Co..... 10
Hill, N. N., Brass Co..... 12
Hill, W. S., Electric Co.....
Hobart Electric Mfg. Co.....1, 24
Hotel Somerset..... 45
Humphrey, Henry H..... 82

(*Continued on page 32.*)

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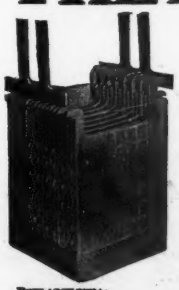

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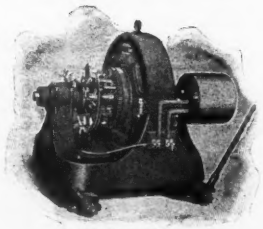

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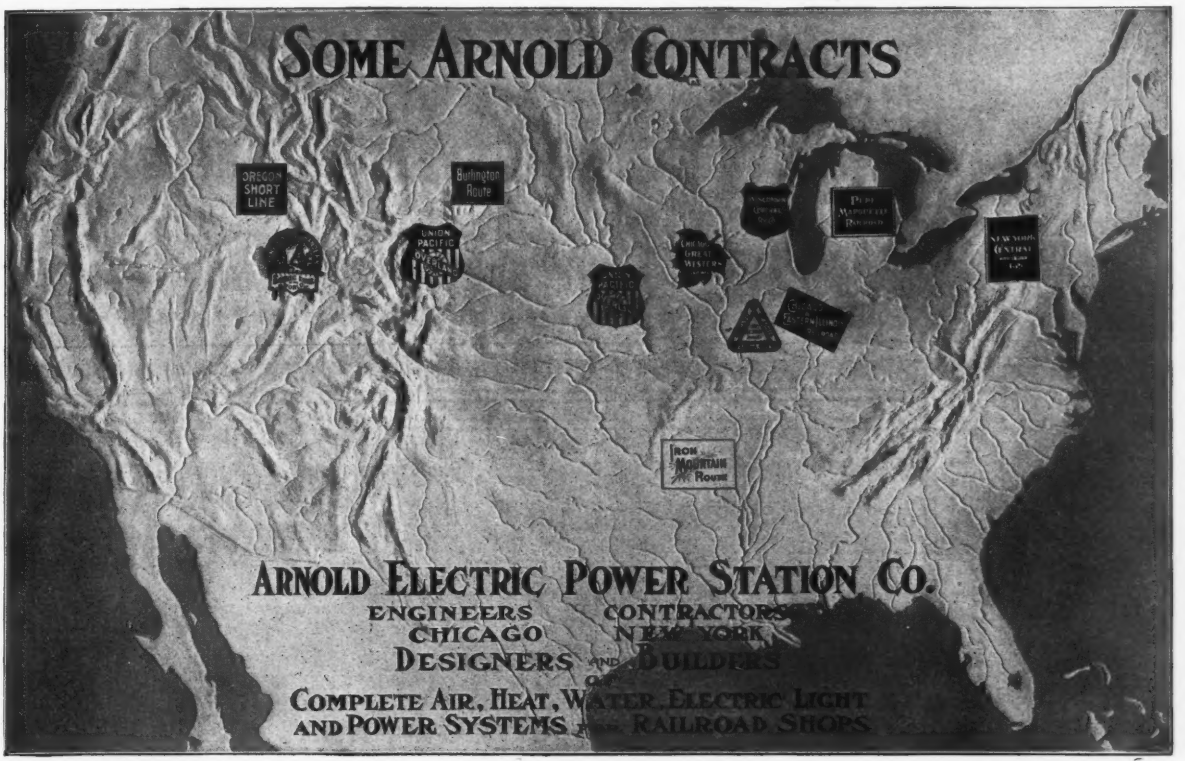

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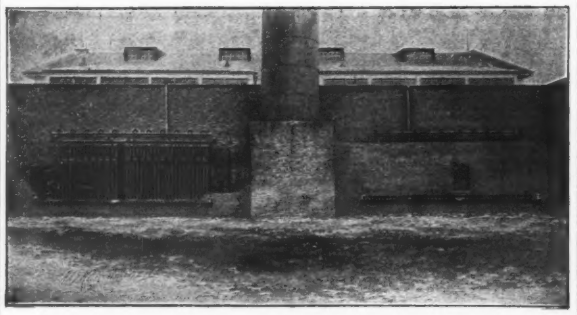

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ALPHABETICAL INDEX.

(*Continued from page 28.*)

H

Hunt Co., C. W. 78
Hunter Fan & Motor Co. 19

I

Incandescent Electric Light Manipulator Co. 4
India Rubber & Gutta Percha Insulating Co. 43,92
Indiana Rubber & Insulated Wire Co. 1
Index of the Technical Press 4
Internat'l Correspondence Schools 15
Inventive Age Publishing Co. 76
Ithaca Electric & Novelty Co 76

J

Jandus Electric Co. 2
Jeffrey Mfg. Co. 12
Jessop & Sons, Wm. 16
Johns-Manville Co., H. W. 29
Johnson & Morton 77
Jordan Bros. 77

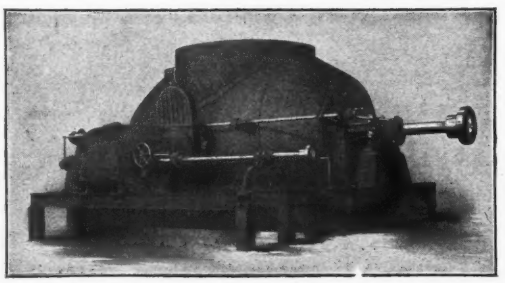
K

Kellogg Switchboard and Supply Co. 87
Kelly, John 16
Kester Electric Co. 4
Keystone Electric Co. 30
Kinsman Elec. & Ry. Supply Co. 83
Klein & Sons, Mathias 77
Knott Apparatus Co., L. E. 82
Knowles Edward R. 82

L

La Roche, F. A. 31
Lawrence-Hall Electric Co. 29
Leeds & Northrup Co 36
Leffel & Co., James 83
Lindsley Bros. Co 5
Locke Insulator Mfg. Co. 32
Lombard Governor Co. 14
Lundin Electric & Machine Co. 92
Lunkenheimer Co. 82
Lyndon, Lamar 29
M
Machado & Roller 86
Manhattan Dial Co. 78
Manhattan Electrical Supply Co. 78
Manross, F. N. 78
Marshall, Wm. 37
Marshall-Sanders Co 75
Matthews & Bro., W. N. 76
McGill University 82
McTighe, Thos. J. 79
Mica Insulator Co. 46
Michigan College of Mines 10
Miller Anchor Co. 7
Missouri-American Electric Co. 10
Montauk Fire Detecting Wire Co. 79
Morris Company, I. P. 32
Morse Twist Drill Co. 14
Munder Elec. Co. 92
Munsell & Co., Eugene 82
Murdock Corporation 9
N
National Battery Co. 1
National Carbon Co. 26
National Conduit & Cable Co. 1
National Electric Co. 26
National India Rubber Co. 1
Nernst Lamp Co. 10
New England Butt Co. 7
New England Engineering Co. 81
New Jersey Central R. R. 1
New Process Raw Hide Co. 1
New York & Ohio Co. 5
New York Cent. & Hud. Riv. R. R. 1
New York Insulated Wire Co. 86
New York Telephone Co. 85
North Electric Co. 1.11
O
Okonite Co. 77
Olds Gasoline Engine Works 1
Ostrander, W. R. & Co. 46
P
Paiste Co., H. T. 13
Pairpoint Corporation 1
Pardridge Shade & Reflector Co. 21,26
Peerless Electric Co. 83
Peirce, C. L., Jr. 78
Pennsylvania R. R. 83
Phelan, D. W. 1
Phœnix Glass Co. 75
Phelps Co. 1
Phillips, Eugene F., Bare and Insulated Wires 1

(*Continued on page 36.*)



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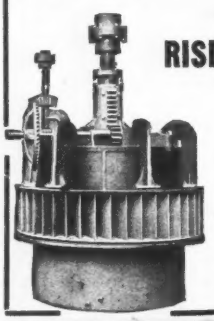

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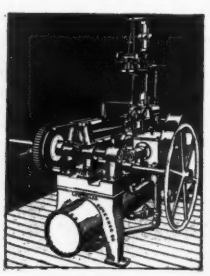

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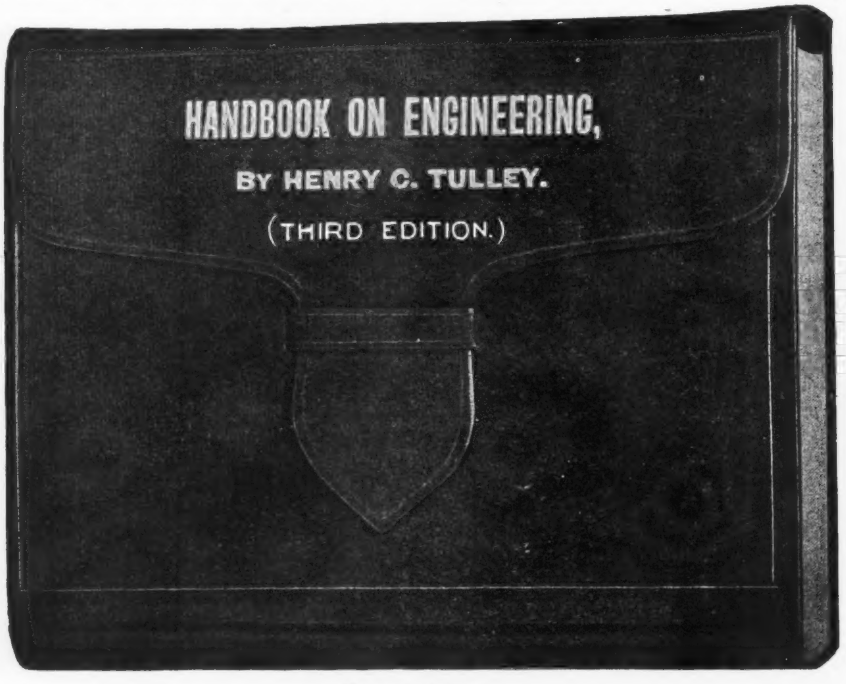

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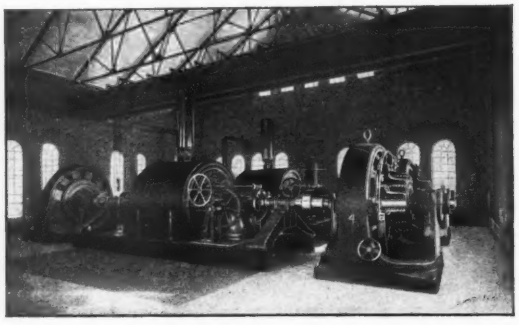

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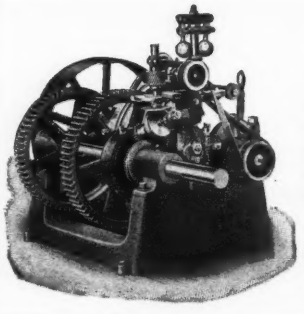

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ALPHABETICAL INDEX.—(*Continued from page 32.*)

P

Phillips Insulated Wire Co. 92
Phosphor-Bronze Smelting Co. 77
Pignolet, Louis M. 29
Polytechnic Institute of Brooklyn. 76
Portland Co., The 6
Power Installation Co. 82
Powers Co., The E. L. 82
Prentiss Clock Improvement Co. 79

R

Rae, Frank B. 82
Reidy & Co., J. J. 78
Reisinger, Hugo 3
Reynolds Elec. Flasher Mfg. Co. 75
Reynolds Mfg. Co 10
Risdon-Alcott Turbine Co. 32
Rittenhouse-Miller Co. 46
Robbins & Myers Co. 19
Robertson & Sons, James L 75
Roche, Wm.
Roe & Co., Albert 82
Roebling's Sons Co., John A. 92
Rossiter, MacGovern & Co. 77

S

Safety Insulated Wire & Cable Co. 10
Sawyer-Man Electric Co.
Schwerdtle Stamp Co. 77
Seaman, J. H. 77
Sharp Machine Works, L. C. 78
Shelby Electric Company 1,16
Siggers & Siggers 76
Simplex Electrical Co. 1
Simplex Electric Heating Co. 79
Smith Company, S. Morgan 32
Smith Storage Battery Co. 8
Southern Mills.
Spon & Chamberlain 13
Sprague Electric Co 20,46
Standard Electrical Mfg. Co. 32
Standard Paint Co
Standard Underground Cable Co. 30
Standard Vitrified Conduit Co. 16
Stanley, Arthur F.
Stanley Electric Mfg. Co. 1,27
Stanley Instrument Co. 6
Stanley & Patterson. 10
Stanton, Le Roy W. 82
Sterling Electrical Mfg. Co. 32
Sterling Varnish Co. 46
Stirling Co. 79
Stow Manufacturing Co. 26

S

Stromberg-Carlson Telephone Mfg. Co. 88
Stuart-Howland Co. 1
Swedish-American Telephone Co.

T

Thomas & Sons Co., R. 33
Thresher Electric Co 80
Triumph Electric Co. 30
Trumbull Electric Mfg. Co.
Turbine Engineering Co 81

U

United Electric Heating Co. 75
U. S. Battery Co. 92
U. S. Mineral Wool Co. 4

V

Valentine-Clark Co. 83
Vanderman Plumbing & Heating Co. 29
Van Loan Co., I. S. 78
Van Nostrand Company, D.
Varley Duplex Magnet Co. 75
Viaduct Mfg. Co. 86
Vindex Electric Co

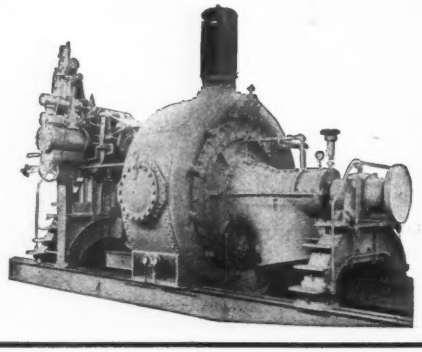
W

Wagner Electric Mfg. Co. 43
Wagor, P. R., Mfg. Co.
Walker Co. 75
Walsh's Sons Co. 78
Wanted. 78
War Department 78
Warner, W. F. 7
Warren Electric Mfg. Co. 24
Warren Electric & Specialty Co. 1
Weiss, W. F. 76
Wesco Supply Co 22
Westcott, Geo. F. 82
Western Electric Co. 30
Western Telephone Mfg. Co.
Westinghouse Air Brake Co.
Westinghouse Electric & Mfg. Co. 91
Westinghouse Machine Co. 90
Weston Electrical Instrument Co. 46
Wheeler Reflector Co. 29
White & Co., J. G. 82
Whitney Electrical Inst. Co.
Wilmerding, C. H. 82
Woodward Governor Co. 36
Wyckoff Pipe & Creosoting Co. 46

Y

Yost Electric Mfg. Co. 4

(*Continued on page 40.*)



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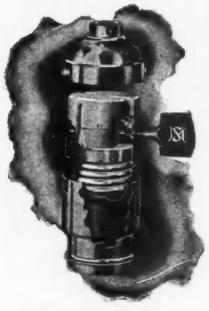

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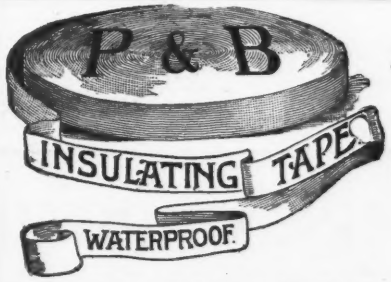

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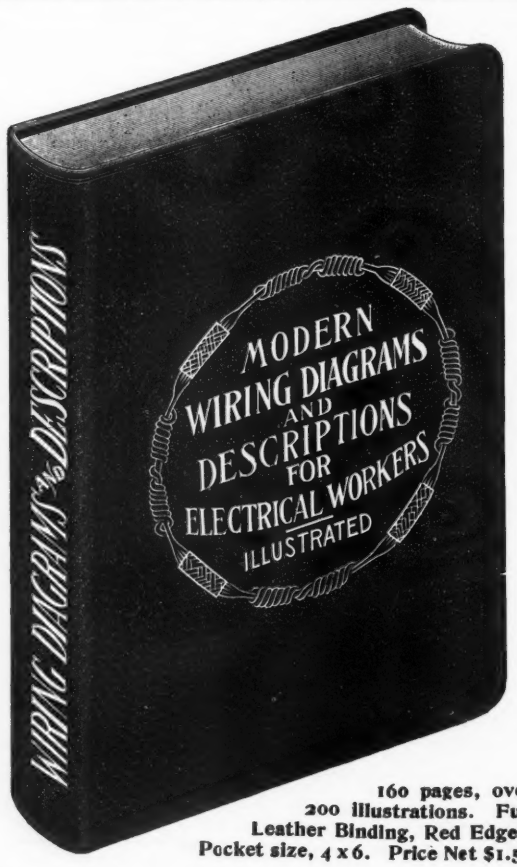

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Telephones, 7 diagrams.
Telegraph, 3 diagrams.
Gas lighting by electricity, 4 diagrams.
Automatic fire alarm, 1 diagram.
Primary batteries, 7 diagrams.
Connecting up, 3 diagrams.
Miscellaneous circuits, 6 diagrams.
Electric lighting, 30 diagrams.
Arc lamps, 4 diagrams.
Meters, 28 diagrams
Motors, 21 diagrams.
Generators, 7 diagrams.
Compensators, 1 diagram.
Switchboards, 3 diagrams.
Ground detectors, 10 diagrams.
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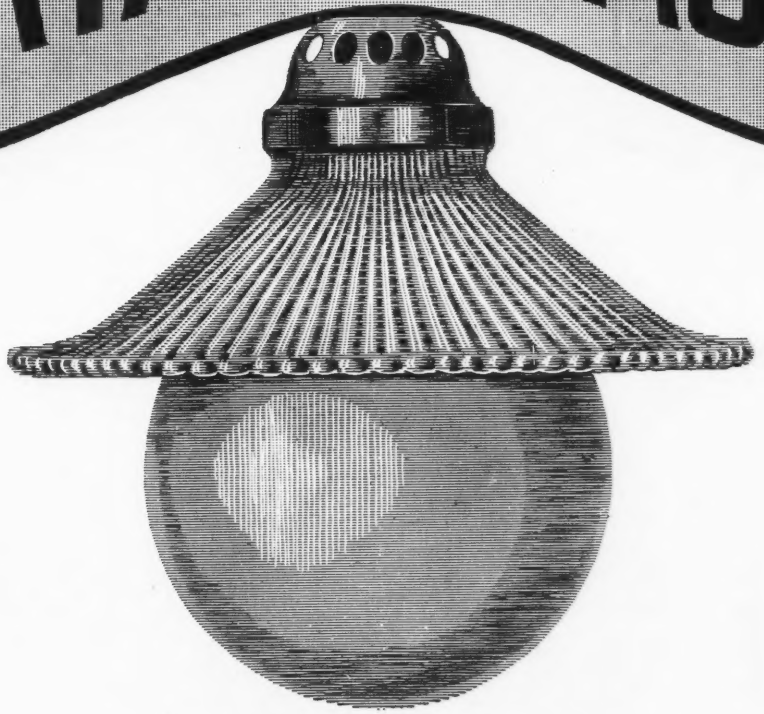

THE IMPERIAL PRISMO LAMP

WITH CRYSTAL PRISMATIC REFLECTOR

We have just issued our new catalogue on the

PRISMO LAMP

If you have not received one please write for it

We shall be pleased to receive your orders

THE BRYAN-MARSH COMPANY

136 Liberty Street, New York — **Fisher Building, Chicago**

DENVER McPhee Building
CINCINNATI Perin Building
MINNEAPOLIS Lumber Exchange
SAN FRANCISCO Crossley Building

This company is licensed to use the Chemical Exhaust Process of evacuating lamps, which process is essential to the production of a lamp of the highest quality. Every package bears a label as follows:

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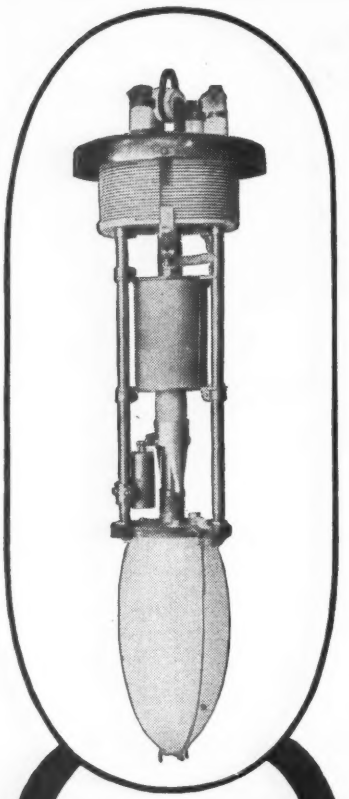
Patent 726,293 April 28, '03
Patent 444,530 Jan. 13, '91
Patent 532,760 Jan. 22, '95



SIMPLICITY

IS ONE OF THE STRONG POINTS OF THE

HEANY ENCLOSED ARC LAMP

Be as strenuous in helping yourself as we are in telling you about it.

The principle of

THE MAGNETIC CLUTCH

Has interested the world's greatest electrical engineers.

Its many advantages are explained in our catalogue—Send for it.

The American Electrical Mfg. Co.

27 NORTH 10th ST. PHILADELPHIA, PA.

CLASSIFIED INDEX

(*Continued from page 36.*)

Adjusters, Incandescent Lamps.
Incan. Elec. Light Manipulator Co.

Air Compressors.
Stilwell-Bierce & Smith-Vaile Co.

Alternators.
Christensen Engineering Co.
Fort Wayne Electric Works.
General Electric Co.
La Roche Co., F. A.
National Electric Co.
Warren Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Anchors, Guy.
Matthews & Bros., W. L.
Miller Anchor Co

Annunciators.
Stanley & Patterson.
Edwards & Co.

Automobile Parts.
Ferodowill Mfg. Co.

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American Carbon & Battery Co.
Bunnell & Co., J. H.
Burnley Battery & Mfg. Co.
Eastern Carbon Works.
Edison Mfg. Co.
Roche, Wm.
Wesco Supply Co.

Batteries, Storage.
American Battery Co.
Columbus Storage Battery Co.
Dayton Electrical Mfg. Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
National Battery Co.
Smith Storage Battery Co.
United States Battery Co.

Bells.
Hill Brass Co., N. N.
Ostrander & Co., W. R.

Belt Dressing.
Dixon Crucible Co., Joseph.

Boilers.
Allis-Chalmers Co.
Babcock & Wilcox Co., The.
Morris Co., I. P.
Stirling & Co., The.

Books, Technical.
Drake & Co., Frederick J.
Electrical Review Pub. Co.
Powers & Co., E. L.
Spon & Chamberlain.

Brackets.
C. L. Peirce, Jr.

Bridle Rings.
Barron & Co., Jas. S.

Brushes, Dynamo.
Eastern Carbon Works.

Cable Hangers.
American Electric Fuse Co.
Barron & Co., Jas. S.
Standard Underground Cable Co.

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New England Butt Co.

Calculating Machines.
Calculagraph Co.

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Cutler-Hammer Mfg. Co
Cutter Electrical Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
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Morris Co., I. P.
Western Electric Co.

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Incan. Elec. Light Manipulating Co.

Climbers.
Klein & Sons, Mathias.
Reidy & Co., J. J.

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Calculagraph Co.

Clusters.
Benjamin Electric Mfg. Co.

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C. W. Hunt Co.
The Jeffrey Mfg. Co.

Coal Mining Machinery.
General Electric Co.
The Jeffrey Mfg. Co.

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Sharp Machine Works, L. C.

Commutator Lubricant.
Allen & Co., L. B.
Hart & Co.

Commutator Segments.
Billings & Spencer Co.

Condensers (Electric).
Marshall, Wm.

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American Circular Loom Co.
American Conduit Co.
American Stone Conduit Co.
American Vitrified Conduit Co.
Camp Co., H. B.
Gest, G. M.
Kelly, John.
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Osburn Flexible Conduit Co
Pittsburg Sewer Pipe & Conduit Co.
Rittenhouse-Miller Co.
Standard Vitrified Conduit Co.
Sprague Electric Co.
Wyckoff Pipe & Creosoting Co.

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Church, L. H.
Benson & Co., Wm. W.

Conduit Rods.
Barron & Co., Jas. S.
Cope, T. J.

Connectors.
Smith & Hemenway Co.

Connectors and Terminals
McIntire Co., The C.

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J. G. White & Co.
New England Engineering Co.

Construction Supplies.
Barron & Co., Jas. S.
T. H Brady.

Cord Adjusters.
Seaman, J. H.

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Eccleston Lumber Co.
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Wyckoff Pipe & Creosoting Co.

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Fort Wayne Electric Works.
General Electric Co.
Gen'l Incandescent Arc Light Co.
Hobart Electric Mfg. Co.
Jordan Bros.
Keystone Electric Co.
National Electric Co.
Peerless Electric Co.
Robbins & Myers Co.
Rossiter, MacGovern & Co.
Sprague Electric Co.
Stanley Electric Mfg. Co
Stow Manufacturing Co.

(*Continued on page 82.*)

IN the history of electrical publishing, the ELECTRICAL REVIEW is the first weekly journal to eliminate "*claims*" and *substantiate* its circulation by showing its records to a competent authority.

Because of a personal call subscription campaign of three years, its paid subscriptions increased to such an extent that the publishers believed they far exceeded those of any other electrical weekly

Its circulation records were then opened to the "American Newspaper Directory," the highest circulation authority.

As a result, the "American Newspaper Directory" rates the ELECTRICAL REVIEW as having shown evidence of over 2,000—paid subscribers—more than any other electrical weekly.

And, too, it is given the "gold mark," meaning that its circulation is of a high class.

These facts may be verified.

—

We believe discriminating advertisers fully realize the value of a journal of *known* circulation — one which courts inquiry and comparison, and offers substantiated facts instead of mere arguments.

HOTEL NOTTINGHAM

COPLEY SQUARE, BOSTON, MASS.
FRANK R. GRACE, Manager

Two Minutes from N. Y., N. H. & B. A. R. R.

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ROOMS $1.50 PER DAY UPWARDS

Chicago Insulated Wire Company

High-Grade Weather-Proof, Magnet, Office, Annunciator Wire & Galvanized Steel Strand

Chicago Office
15 Marine Building

Factory
Sycamore, Illinois

The Hancock Inspirator Co.

MANUFACTURERS OF

THE HANCOCK INSPIRATOR

Hancock Globe Valves
and Check Valves
Ejectors and General
Jet Apparatus

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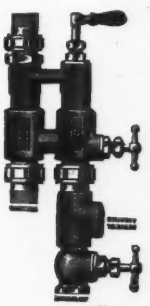
22-24-26 South Canal Street, CHICAGO, ILL.



(1)

The Electrical Review ...

Is used for advertisements inviting proposals for Electrical Work for the United States Government and Municipal and Public Building. ∴ ∴ ∴ ∴ ∴

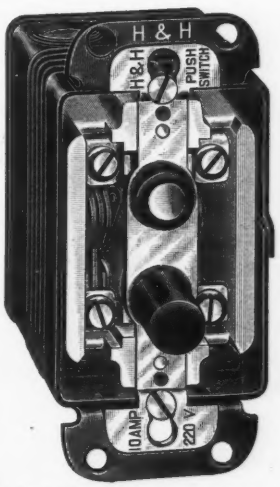
REMEMBER THAT PILLSBURY A.-C. CEILING FANS

1st. Will stir more air than any other fan on the market
2d. All are equipped to operate at two speeds
3d. They are furnished in either plain or ornamental finish
4th. They are thoroughly guaranteed
5th. THE PRICE IS RIGHT

Manufactured by CENTURY ELECTRIC COMPANY
1007-9-11 LOCUST STREET ST. LOUIS, MO., U. S. A.

The Proof of a good switch is in its operation.

DID YOU EVER HEAR OF A "HART" SWITCH NOT GIVING PERMANENT SATISFACTION?
WE HAVEN'T



Push Switch in No. 1 W. Wall Case

Rect. Base Flush Switch in No. 1 W. Wall Case

TRY THEM WHEN MAKING YOUR NEXT INSTALLATION

CATALOGUE "E" IS YOURS FOR THE ASKING

THE HART AND HEGEMAN MFG. CO.

92 Union Place Hartford, Conn.

(1)

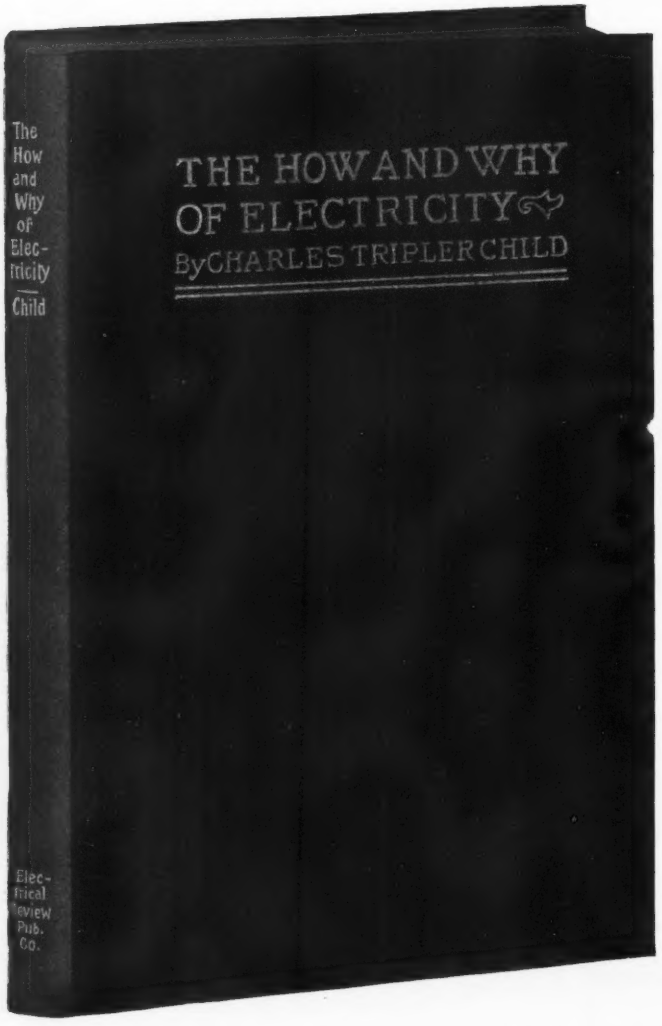
"The How and Why of Electricity"

By CHARLES TRIPLER CHILD, Late Technical Editor of the Electrical Review

The author of this book was one of the ablest and most easily understood writers on electrical subjects. "The How and Why of Electricity" treats of the properties of electricity, of how it is generated, handled, controlled, measured and set to work, and explains the operation of electrical apparatus.

It is a book the business man, the professional man, the architect, the contractor, the student, the electrician, in fact all persons in professional or business life, can read with interest and profit.

It brings you up to date in knowledge of electrical achievements and electrical conditions.



CONTENTS

CHAPTER

Preface.
I The Electric Current.
II The Electric Battery.
III The Effects of Electric Flow in the Circuit—Heat and Chemical Action.
IV The Effects of Electric Flow Outside the Circuit—Magnetism and Induction—The Electrical Units.
V Electromagnets—The Telegraph.
VI Electric Signaling Apparatus.
VII The Relations Between Magnets and Electric Currents.
VIII Induction and Reactive Coils.
IX The Telephone.
X Telephone Accessories.
XI The Mechanical Generation of Electricity.
XII The Dynamo Machine.
XIII Various Types of Dynamo Machines.
XIV Alternators—Polyphase Currents.
XV The Electric Motor.
XVI The Electric Railway.
XVII Polyphase Currents and Motors.
XVIII Electrical Power Transmission.
XIX The Incandescent Light.
XX The Arc Light.
XXI Electrochemistry—Storage Batteries.
XXII Wireless Telegraphy.
XXIII Radiation—X-Rays.

"The descriptions are helped out with cuts and diagrams that really explain. We know nothing that gives so much help on a difficult and complex matter in so short a space."—*New York Sun, December 27, 1902.*

"Is admirably adapted to instruct the non-technical reader who is interested in that subject. * * * Mr. Child enjoyed a high reputation for the clearness and intelligibility of his writing, and the volume in question exhibits these qualities."—*New York Tribune, December 26, 1902.*

"We can unhesitatingly recommend this book to all non-technical readers, who desire a simple and yet correct account of the different features of modern electrical development."—*Street Railway Journal, New York, January 10, 1903.*

"An excellent manual of the uses of electricity, and while not intended in any way as a text-book, the work is of much value to readers, both professional and lay."—*National Electrical Contractor.*

"Mr. Child has left a good book; one that we can heartily commend to the non-technical readers for whom it was written; they will not be led astray by platitudinous nonsense, but will receive solid, exact information, if simply expressed."—*Western Electrician, Chicago, February 21, 1903.*

"The book is a handy one: just what nine men in ten demand in order to seize rapidly the practical side of electricity."—*San Francisco Chronicle, February 7, 1903.*

"In spite of the great mass of electrical literature already existing it is one of the first good books of its kind. * * * It will find a large circle of readers on its evident merits."—*Engineering News, New York, February 19, 1903.*

PRICE $1.00, POSTAGE PREPAID

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BOOK DEPARTMENT **13 PARK ROW, NEW YORK**

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Multiple or Series

Patented April 19, 1904 Non-Infringing
Passed by Underwriters

We understand that the Benjamin Electric Mfg. Co. is notifying the public that it has brought suit against us alleging infringement of their patents. We take this opportunity to say that a suit has been brought, and we cordially welcome the opportunity to prove legally that "Dale's Wireless Clusters" **do not infringe**; this we are certain of, and our customers need pay no attention to this action. We stand ready to defend any action which may be brought against us or our customers, and furthermore guarantee purchasers against any loss or damage by reason of any action on the part of the Benjamin Electric Mfg. Co., or any other company or individual for alleged infringement.

THE DALE COMPANY

Lewis A. Dale

President

THE DALE CO.
NEW YORK, U. S. A.

India Rubber and Gutta Percha Insulating Co.

Authorized Manufacturers of

HABIRSHAW

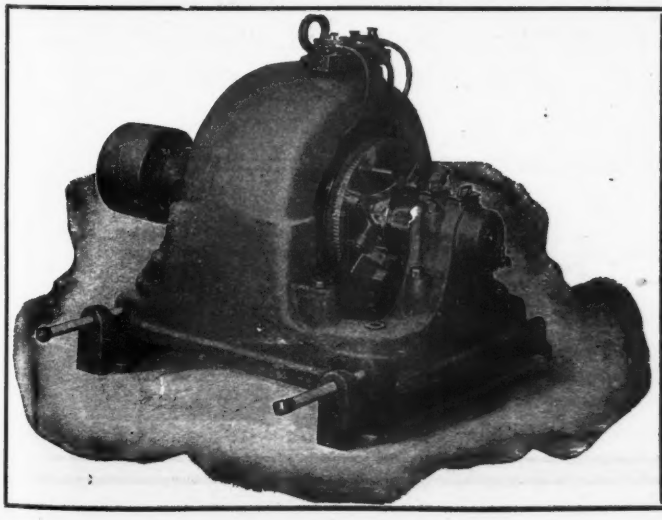
WIRES and CABLES

Lighting, Power Transmission, Railway, Telephone, Telegraph

SIGNAL CABLES

OFFICE AND WORKS
YONKERS, N. Y.
W. M. HABIRSHAW, President and General Manager

SALES DEPARTMENT
13-15 Cortlandt St., NEW YORK CITY
J. B. OLSON, Manager of Sales



Are You Satisfied with Your Present Earnings?

If not, then advocate the use of our

SINGLE-PHASE SELF-STARTING MOTORS

Wagner Electric Mfg. Co.

St. Louis, Mo., U. S. A. (2)

The Pressure on Our Columns for May 21 is Unusually Heavy

WE must ask the cooperation of our advertisers in sending in copy early for the two issues of

MAY 21 and
MAY 28

Copy for the first issue should all be in this office not later than May 17. Copy for the second issue should be in this office not later than May 25.

Our issue of May 21 will have a large, additional, general distribution, and, besides, will be well distributed at the convention in Boston. The advertising in that issue will undoubtedly be seen by every one attending the convention of the National Electric Light Association.

If you intend to make an exhibit and announce it, or if you desire to say anything to the delegates, the ELECTRICAL REVIEW is the medium through which to present your statements effectively and directly.

The issue of May 28 will contain the report of the proceedings, names of those present, papers, etc., and will, as usual, be very complete and full of interest, and will be widely read.

We desire to give you our very best attention, and to do this must ask your kind cooperation in seeing that copy and cuts for your advertising reach this office at the earliest moment possible.

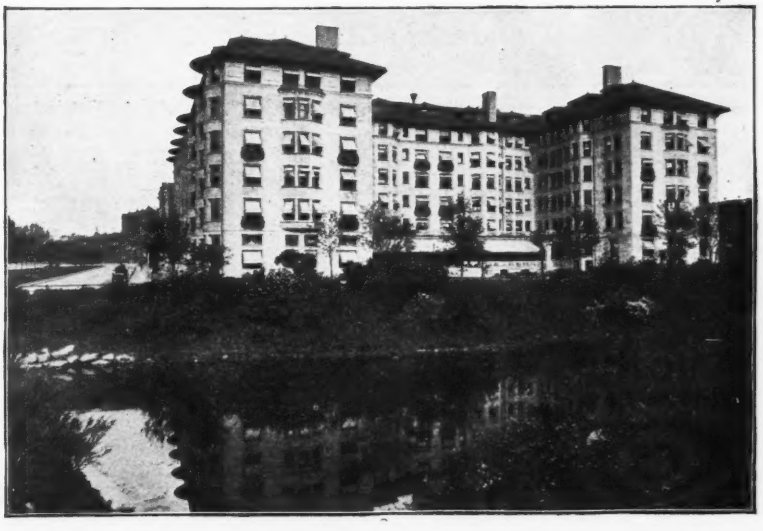
ELECTRICAL REVIEW

13 PARK ROW - - - - - - NEW YORK

Hotel Somerset, Boston

Commonwealth Avenue

BOSTON'S NEWEST AND MOST PALATIAL HOTEL



While delightfully situated at entrance to Park and Fenway, and absolutely open and having unobstructed air and view on all sides, the "Somerset" is only ten minutes from Railway Stations, Theatres and Shops. The ideal "stopping off" place for families and tourists en route to and from the Mountains and Seashore.

Open Air Restaurant **Alfred S. Amer, Manager**

Send for Booklet

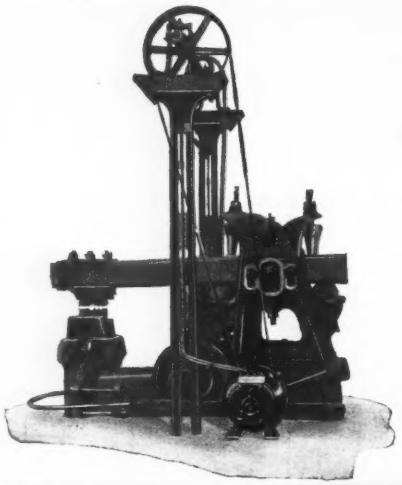
THE BEST FOR USE AS CONTACT POINTS IN TELEPHONES, SPARK COILS AND OTHER ELECTRICAL APPARATUS

PLATINUM RIVETS

408-410-412-414 N. J. R. R. AVE. NEWARK, N. J.

BAKER & COMPANY, INC.
ARTISANS IN PLATINUM

C. O. BAKER, Pres. C. W. BAKER, Vice-Pres.
NEW YORK, 120 LIBERTY ST.



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Of Superior Design and Construction

Our motors are built on scientific principles and are unequaled in efficiency, compactness, durability and commercial value. They have a world-wide reputation for excellence. Write for bulletin No. 2066.

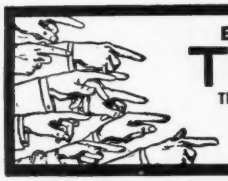
SPRAGUE ELECTRIC COMPANY

General Offices: 527 W. 34th St., NEW YORK

STERLING BLACK PLASTIC INSULATOR

One hundred days' continuous baking at 180° Fr. will not make it brittle.
Water Repellant. Oil Proof.

THE STERLING VARNISH CO., PITTSBURG, PA.

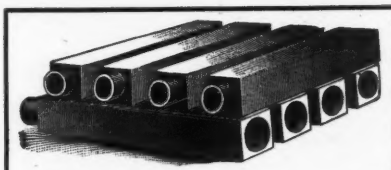


EXPERIENCED HANDS POINT TO
The Allen Soldering Stick, Paste and Salts
They have been a success for over 12 years and get better day by day—a sample will tell you why
L. B. Allen Co. (Inc.,) 1335 Columbia Ave. Chicago, Ill.

Electrical Testing Instruments

State Requirements and write for Prices

JAMES G. BIDDLE, 1112 Chestnut St., Philadelphia



THE WYCKOFF PIPE & CREOSOTING CO., Inc.
MANUFACTURERS OF
Wyckoff Wooden Conduits
Poles, Cross-Arms, R. R. Ties & Lumber
OFFICE STAMFORD, CONN. WORKS PORTSMOUTH, VA.

The "P-K" PUSHIN ATTACHMENT PLUG
Made by
H. T. PAISTE CO.
PHILADELPHIA, PA.

Just an Easy, Even "push in" and it's attached

Your request brings a free sample

"The Leading Specialty Manufacturers"

EUREKA FLEXIBLE CONDUIT
RITTENHOUSE-MILLER CO.
12th AND BUTTONWOOD STS.
PHILADELPHIA

AMERICAN STORAGE CELLS ARE THE BEST
SEND FOR DESCRIPTIVE CIRCULAR
AMERICAN BATTERY CO.
173 S. CLINTON ST., CHICAGO, ILL.
ESTABLISHED 1899

INDIA MICA

We Import Directly from India and Handle the Output of the Best Mines. A Large Stock Constantly on Hand Enables Us to Make Prompt Shipments ALL OTHER QUALITIES. Prices Low.
EUGENE MUNSELL & CO.
CHICAGO NEW YORK 2

WESTON Electrical Instrument Co.

New York Office, 74 Cortlandt St. Waverly Park, NEWARK, N. J.

BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstra-se.
LONDON: Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE: E. H. Cadiot, 12 Rue St. Georges.

ILLUMINATED DIAL, STATION INSTRUMENTS

These instruments are constructed upon the same general principle as our regular Standard Portable Direct-Current Voltmeters and Ammeters, but are much larger and the working parts are enclosed in a neatly designed, dust-proof, cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Ammeter, Style B.

WESTON STANDARD

Portable, Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct-Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

EDISON MINIATURE LAMPS

have been for twenty years

THE STANDARD OF THE WORLD

and are to-day more largely used than all other makes combined.

SERVICEABLE, ECONOMICAL, RELIABLE.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE AND MINIATURE LAMP DEPT.

General Electric Company,
Harrison, N. J.

1

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED MAY 3, 1904.

758,610 Controller for electric motors; Thomas E. Barnum, Milwaukee, Wis.

758,621 High-tension circuit-breakers; Harry P. Davis, Pittsburg, Pa.

758,623 Telephone system; William W. Dean, Chicago, Ill.

758,631 Collector rings and brush-holders; Karl F. Elers, Pittsburg, Pa.

758,633 Wire stretcher; Charles W. Epperson, Belt, Mont.

758,634 Driving mechanism for motor cars; Henry J. Fisher, London, England.

758,635 Direct-current generator; William H. Foot, Wilkinsburg, Pa.

758,638 Lightning arrester; Louis R. Gaw, Asbury Park, N. J.

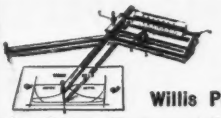
758,644 Electric arc lamp; Thomas Hamilton-Adams, London, England.

758,646 Fuse block; John A. Heany, York, Pa.

758,647 Electric safety fuse or cut-out; John A. Heany, York, Pa.

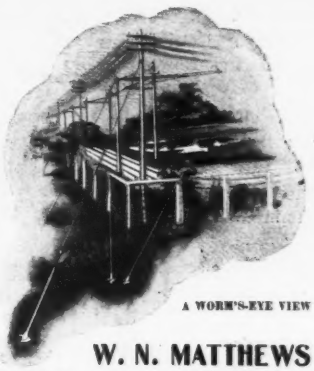
(Continued on page 76)

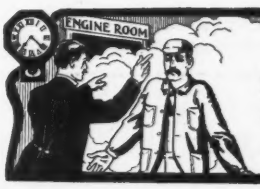
HYLO
DONT BUY ELECTRIC LAMPS TILL YOU GET OUR CATALOGUE AND PRICES
THE PHELPS COMPANY
29 ROWLAND ST, DETROIT, MICH.


Drop Old Method
Willis Planimeter
gives M. E. P. without computation. Moderate in price.
JAS. L. ROBERTSON New York

SWITCHBOARDS
Send for Drawings
Specifications and Figures
THE WALKER COMPANY
2318-2338 Noble St., PHILA.
NEW YORK, 39 Cortlandt St. CHICAGO: Old Colony Bldg.

FLASHERS
THE Reynolds
IMPROVED ELECTRIC SIGN FLASHERS
WILL CREATE NEW BUSINESS FOR YOU DURING THE DULL SUMMER MONTHS
THEY ARE NOT AN EXPERIMENT BUT A PROVEN SUCCESS
REYNOLDS ELECTRIC FLASHER MANUFACTURING CO., Inc.
225 FIFTH AVENUE, CHICAGO

FOR GUYING POLES ETC

A WORM'S-EYE VIEW
USE STOMBAUGH ANCHORS
W. N. MATTHEWS & BRO.
200 CARLETON BLDG. DISTRIBUTERS ST. LOUIS


"NO WONDER YOUR COMMUTATOR SPARKS"
You forgot to use THE ALLEN
COMMUTATOR LUBRICANT
It preserves, lubricates, brightens, prevents cutting and sparking and prolongs the life of your commutator.
TRY IT—SEND FOR A BIG SAMPLE FREE
L. B. ALLEN CO. (Inc.), 1235 Columbia Ave. CHICAGO, ILL.

ELECTRIC HEATING IRONS

AND OTHER DEVICES
Highest Efficiency—Neatest Design
Best Construction—Greatest Durability
UNITED ELECTRIC HEATING CO.
DETROIT MICH., U. S. A.

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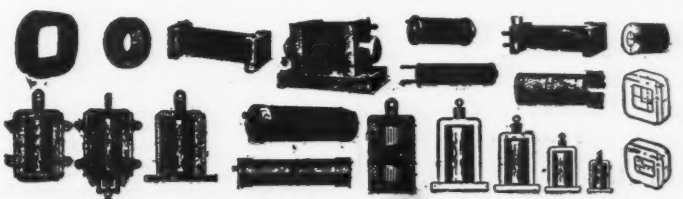
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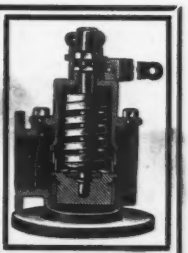
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758,726 Indicating or recording dynamometer; Edward Weston, Newark, and Adelbert O. Benecke, Vailsburg, N. J.

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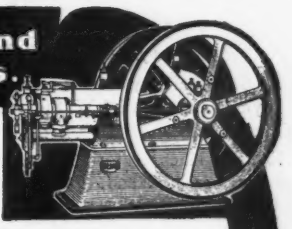

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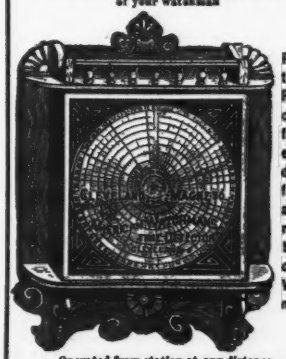

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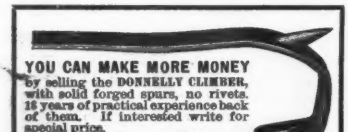
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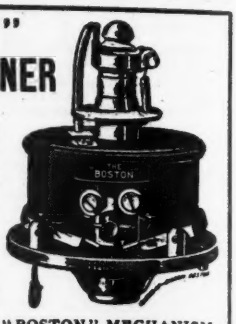
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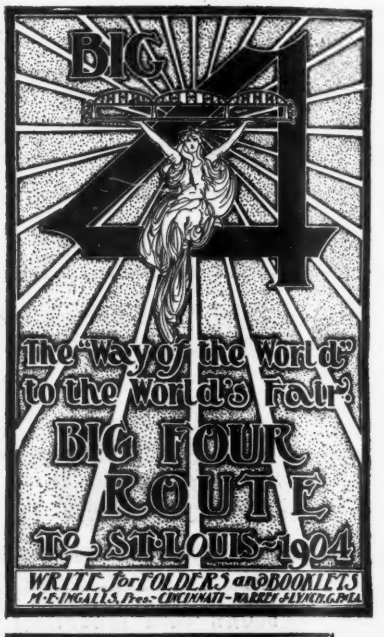
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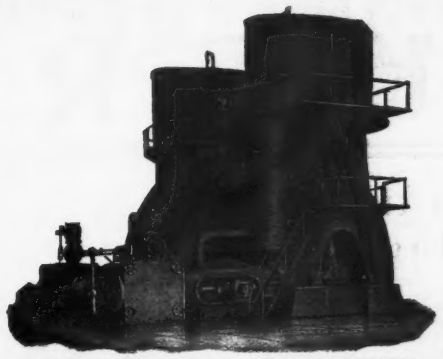

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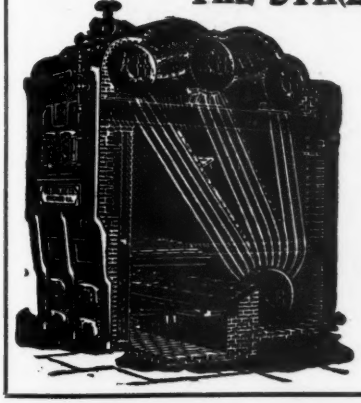

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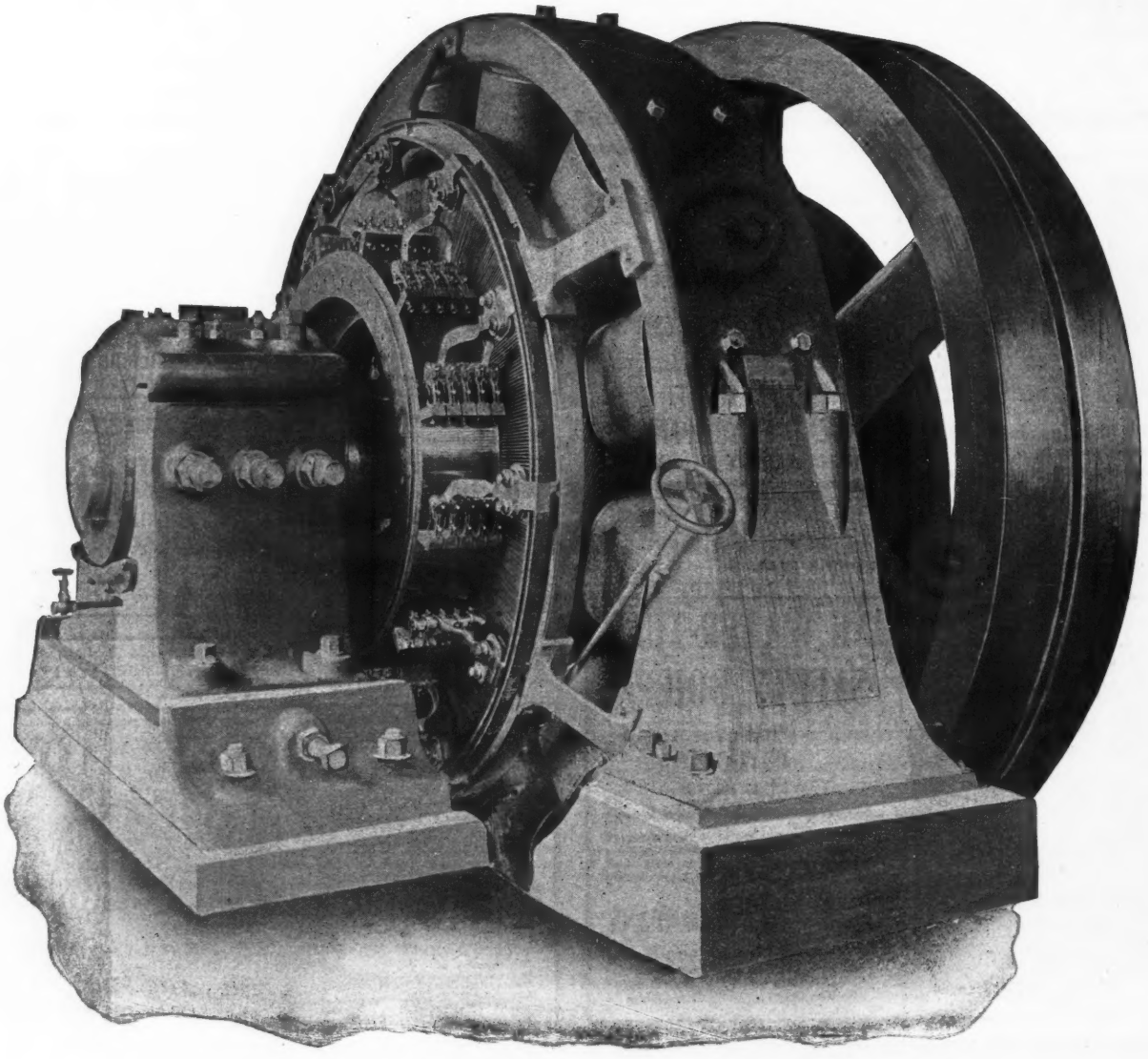

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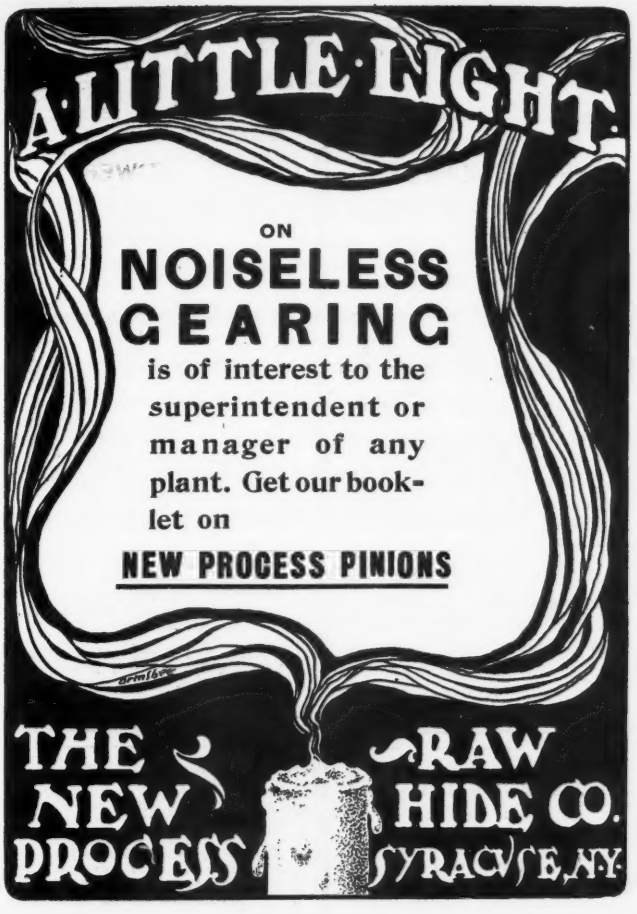
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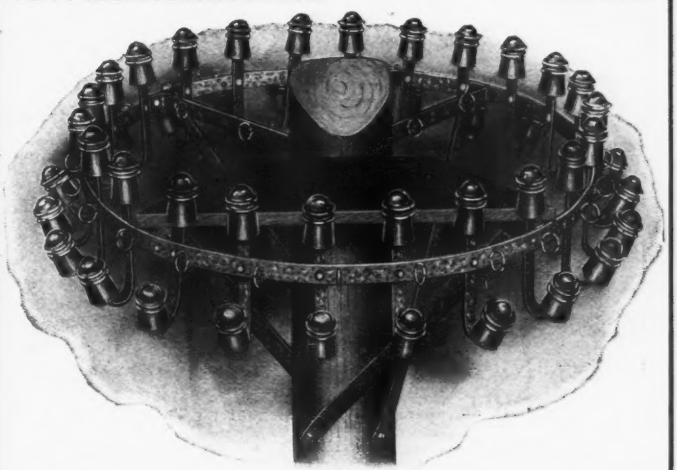

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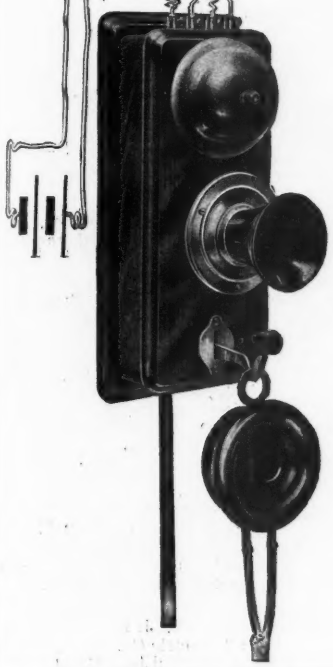

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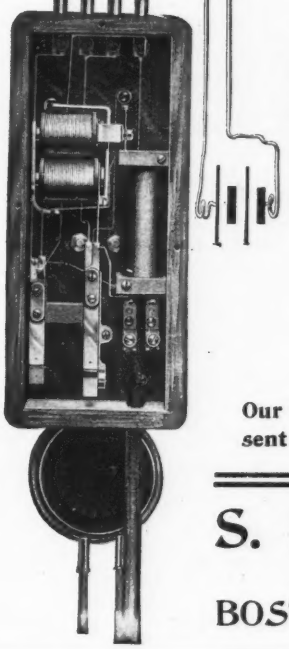

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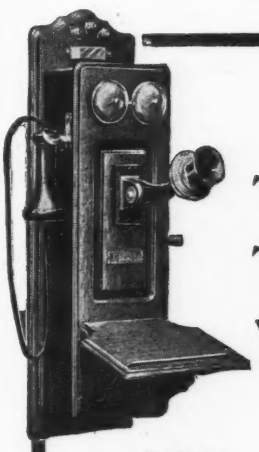

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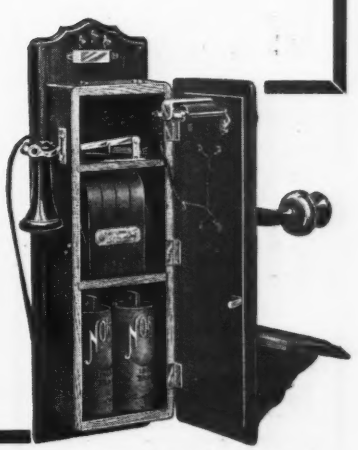

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Schwerdtle Stamp Co., The.

Numbering Machines.
Bates Machine Co.

(*Continued on page 88.*)

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Massachusetts Chemical Co.
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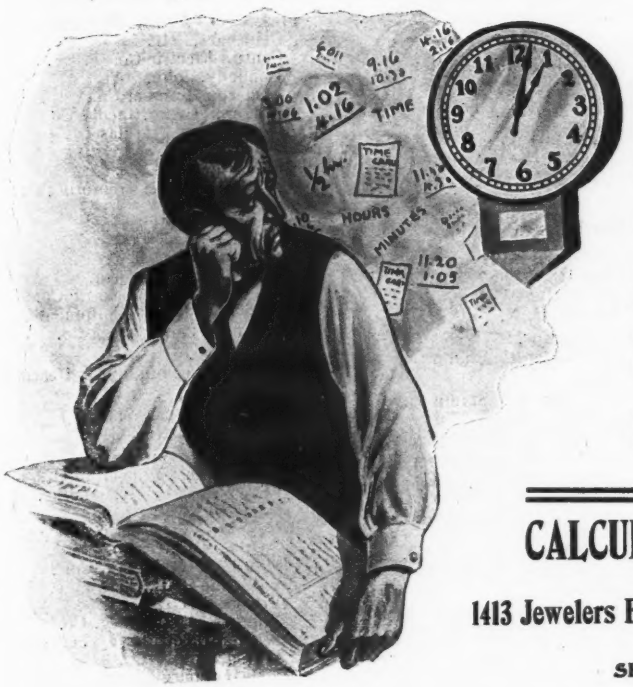

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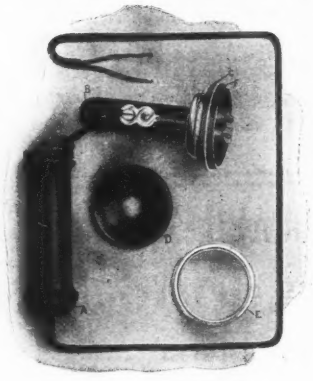

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(Continued from page 86.)

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Phelps Co.
Yost Electric Mfg. Co.

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Electric Storage Battery Co
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La Roche Co., F. A.
Wagner Electric Mfg Co.
Walker Co.
Western Electric Co.

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Abbott, Eugene B.
Central Electric Co.
Chase-Shawmut Co.
Cutter Electrical & Mfg. Co.
Edwards & Co.
General Electric Co.
Gen'l Incandescent Arc Light Co.
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Lunkenheimer Co., The.

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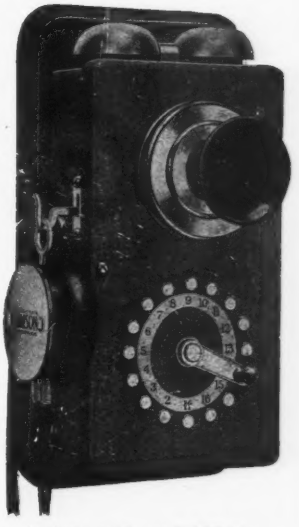

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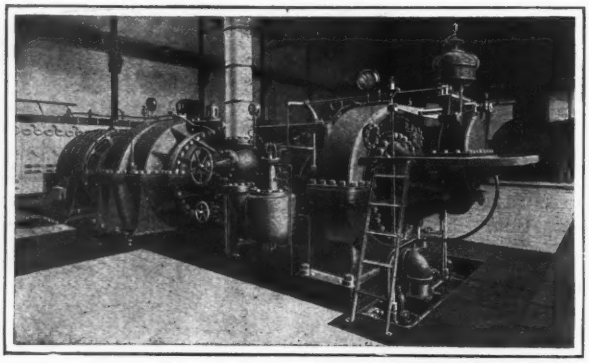

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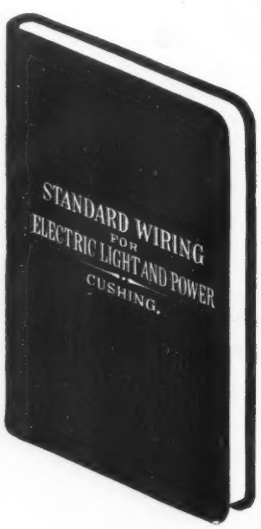

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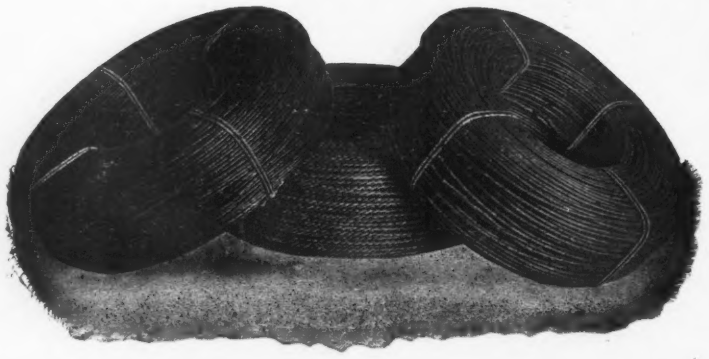

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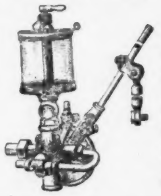

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